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Ameritech Installation, Administration And Workmanship Requirements

This publication is an Installation Suppliers' guide for equipment and equipment systems that will be installed, removed or modified in all types of Telephone Company facilities. This document reflects current requirements that are subject to revision or change for any reason, including but not limited to conformity with standards declared by various agencies, utilization of advances in the state of technical arts, or the reflection of changes in the design of any equipment, techniques or procedures described or referred to herein.

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TECHNICAL REFERENCE NOTICE

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GENERAL

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1. INTRODUCTION

1.1. DOCUMENT OVERVIEW

1.1.1. DOCUMENT PURPOSE

This document has been prepared to provide Suppliers of installation services (hereafter referred to as Supplier[s]) with the general requirements necessary to effectively interface with Ameritech when equipment is to be installed, modified, and/or removed, or services are to be performed under a contract between the Supplier and Ameritech. These requirements will be used as one of the criteria for AOC (Ameritech Operating Company) job acceptance.

1.1.2. DOCUMENT ORDERING INFORMATION

A copy of this document may be obtained in the following manner:

Ameritech personnel and vendors may order copies of this document from the Document Order Desk on (847)248-4324. Please identify yourself as either an Ameritech employee or a vendor and they will fax you the appropriate document order form.

1.1.3. CONFLICT OF TERMS

In the event any requirements contained in this document conflict with the terms and conditions of the contract between the Supplier and Ameritech, the contract terms and conditions shall prevail.

1.1.4. ORGANIZATION RESPONSIBILITIES

Within Ameritech, various organizations have assigned responsibilities that relate to the installation effort. Therefore, the administrative requirements outlined herein shall be adhered to in order to ensure proper coordination and cooperation prior to, during, and upon completion of an installation activity. These installation and documentation requirements also are applicable to all Ameritech personnel performing installation/removal/rearrangement work within an Ameritech office or equipment location.

1.1.5. AOC REPRESENTATIVE RESPONSIBILITIES

The AOC representative, referred to herein, is the Equipment Engineer. (In some cases, depending on equipment type, this could be the outside plant engineer.) The person is listed on the face sheet of the Telephone Equipment Order (TEO) or the Purchase Order (PO), or any

agent as designated by the Equipment Engineer. The AOC representative or designated agent may observe all phases of the installation activity for the purpose of inspecting Supplier services and reviewing job progress.

1.1.6. SERVICE IMPAIRMENT RESPONSIBILITY

Job site AOC personnel shall have the right to suspend Supplier's installation activity if, in the judgment of the job site AOC personnel, the Supplier's activities could cause a service impairment. Suspension of installation activities for other reasons, including but not limited to Supplier-caused unsafe working conditions and/or Supplier's non-conformance with these requirements, must be approved by the AOC representative prior to the suspension.

1.1.7. DOCUMENT REVISIONS

Ameritech reserves the right, without prior notice, to revise the document for any reason, including but not limited to, changes relating to reporting schemes, forms or technical content

1.2. PURPOSE

1.2.1. DOCUMENT APPLICABILITY

The installation requirements outlined in this document are applicable to all types of telecommunication equipment installations, including but not limited to switching, transmission, and power products. This document is not necessarily all inclusive and is intended to be used in conjunction with the equipment manufacturer's product-specific installation manuals, product-specific equipment drawings, and other documents attached to or specified in the contract between the Supplier and Ameritech. It shall be the Supplier's responsibility to notify the AOC representative of any discrepancy between the manufacturer's installation manuals or drawings and these requirements as soon as a discrepancy becomes apparent. Resolution of any such discrepancy shall be the responsibility of the AOC representative.

1.2.2. CONFLICTING STANDARDS

If the workmanship standards or requirements of an installation Supplier or equipment manufacturer are more stringent than those described in this manual, the more stringent standards shall apply.

1.2.3. SUPPLIER RESPONSIBILITY

The Supplier shall be responsible for ensuring adherence to the requirements outlined in this document.

1.2.4. OVERALL INSTALLATION REQUIREMENTS

The intent of this document is to familiarize the Supplier with the AOC's installation requirements by:

A. Outlining the general requirements for the installation operation.

B. Defining the necessary documentation required for the installation activity.

C. Identifying the responsible AOC point-of-contact for the various aspects of the installation operation.

D. Outlining precautions to be taken to prevent service impairment during the installation activity.

E. Defining the installation start, job completion and job acceptance requirements.

1.3. DOCUMENT ORGANIZATION

1.3.1. DOCUMENT SELECTION REQUIREMENTS

The requirements presented in this document have been organized to provide the Supplier with an opportunity to understand what is required to satisfy the installation needs of the AOC.

1.3.2. SECTION 2 REQUIREMENTS

Section 2, General Installation Requirements, provides the Supplier with the general requirements.

1.3.3. SECTION 3 REQUIREMENTS

Section 3, Prevention of Service Impairment, outlines the procedures which are essential to safeguarding service, personnel, equipment, and buildings. Also outlined are the requirements and suggested format for preparing a written Method Of Procedure (MOP).

1.3.4. SECTION 4 REQUIREMENTS

Section 4, Job Progress and Acceptance, defines the installation start, in progress, job completion, and job acceptance procedures required during the installation activity.

1.3.5. SECTION 5 REQUIREMENTS

Section 5, Workmanship Requirements, provides the Supplier with workmanship requirements.

1.3.6. SECTION 6 REQUIREMENTS

Section 6, Tables and Figures, contains the figures and tables noted in this document.

1.3.7. SECTION 7 REQUIREMENTS

Section 7, Radio/Tower Installation and Grounding, contains the procedures for grounding radio towers.

1.3.8. DEFINITION OF REQUIRED VS. SUGGESTED WORDING

In all sections of this document, the words "shall," "must" and "will" indicate a mandatory requirement. The words "should" or "may" indicate requirements that cannot always be met due to physical conditions. All effort is to be made to meet the requirements.

1.4. REVISIONS

1.4.1. REVISION FORMAT

This document may require periodic revision. Revisions will result in reissuing an entire section and/or part, or the complete document. The revision or reissue will be identified by a new issue number.

1.4.2. TABLE OF CONTENTS

The Table of Contents will show the current issue numbers for each section and part. A new Table of Contents will be issued with each revision.

1.4.3. CHANGE IDENTIFICATION

Changes incorporated in this issue will be identified on page 1 of this document.

1.5. COMMENTS FORM

1.5.1. FORM FOR COMMENTS ON DOCUMENT

Comments may be submitted using the form provided (Figure 11) in Section 6.

2. GENERAL INSTALLATION REQUIREMENTS

2.1. INTRODUCTION

2.1.1. GENERAL REQUIREMENTS

This section provides the Supplier with the general requirements relative to building facilities, security, safety, etc.

2.1.2. JOINT AMERITECH/VENDOR REVIEW

Some of the requirements outlined in this section, including but not limited to building facilities and building conditions, will require joint review by AOC and Supplier representatives in advance of the start of the installation activity.

2.2. JOB COORDINATION

2.2.1. COORDINATION RESPONSIBILITY

The AOC representative shall be responsible for coordinating the installation activities. To expedite this function, the AOC representative will convene a "Job Coordination Committee" meeting. The Job Coordination Committee may be convened on an informal (i.e., conference call) or formal meeting basis.

2.2.2. MEETING SCHEDULING

Three weeks prior to the scheduled installation start date, the Supplier's designated representative responsible for the job status and progress through AOC job acceptance (who will be a member of the Job Coordination Committee) shall contact the AOC representative to discuss when physical work will start and set a time for convening the Job Coordination Committee.

2.2.3. JOB COORDINATION MEETING

The first Job Coordination Committee meeting shall be held prior to the start of installation activity. The AOC representative may require a joint walk-through of the installation activity area as part of the Job Coordination Committee meeting. This walk-through will identify any precautions that need to be taken to avoid a safety incident or a service impairment. This walk-through will include inspection of cable racks to determine if any special attention needs to be provided due to non-conformance with current Ameritech requirements or cables that are aged. Purpose of the meeting will be to identify and document the following items:

A. The name, job site telephone number, and off-hour telephone number of the Supplier's representative, AOC representative, and other personnel as appropriate.

B. Hours of access and security regulations at job site.

C. A list of major items of equipment to be added or removed, and modifications to be applied.

D. A list and schedule of installation items that will require a written Method Of Procedure.

E. Identify all cable holes that will be accessed during the installation activity and verify they are closed with intumescent material. If any holes are found to be closed without intumescent materials, it will be confirmed that the intumescent material is provided before job start so that the cable holes can be temporarily closed in accordance with Section 5 of this document.

F. The identification and instructions for handling of hazardous material.

G. The procedure for disposal of job-generated debris

H. Any other pertinent information that could affect the job such as informing the installer of:

- Sensitive equipment at the work site.
- Legal limitations and utility locations for the work site.
- Electrostatic discharge (ESD) protection/prevention procedures.
- Special precautions that must be employed as a result of the joint walk-through inspection of the installation activity site.

2.2.4. JOINT WALK-THROUGH BY AMERITECH/VENDOR PERSONNEL (REMOVALS)

While all the requirements listed in paragraph 2.2.2 apply to all orders, the following additional items relating to a removal or cable mining order will also be covered at the Job Coordination Committee meeting:

A. The installation Supplier, AOC representative and local telephone company personnel will jointly perform a walk-through of the removal/mining area so that all involved personnel are aware of work locations and extent of work to be performed. This includes identifying cable racks and cable holes where removal activity will occur.

B. The joint walk-through will also include an inspection of areas identified by the AOC representative as "high-risk." These high-risk areas will require special attention during cable mining or equipment removal. Examples of high-risk areas include areas where AC and DC power cables are mixed, location of old or damaged cables, location of mechanical connectors (such as gutter taps) that may be disturbed, etc. The AOC representative will also highlight the areas that are known to contain armored cable.

C. Review the emergency procedures which include:

- Fire fighting instructions.
- Location of the fire extinguishers and alarms.
- Removal of AC and DC power from the office.
- Location of spare fuses.

D. Review procedures to be followed by the Supplier when notifying the AOC representative of hazardous or unsafe job conditions that are uncovered during the mining/removal operation. A list of minimum job conditions to be noted are provided in paragraph 2.21.3 (10).

E. The AOC representative will inform the vendor of other activities in the building that may affect the removal/mining work. This includes building construction/rearrangements as well as other central office equipment installations/removals.

F. All local requirements and procedures will be reviewed in detail. This includes:

- Determine the appropriate coverage by the telephone company forces during specific work operations.
- Preparation of daily work logs by the Supplier (example form provided in Section 6).
- Personal injury protection and other personnel safety items.
- Acceptance of tools, devices, and techniques to be used during the removal/mining operations.
- Use of thermal scanning devices.

2.2.5. MEETING COORDINATION

Succeeding Job Coordination Committee meetings will be called at the discretion of the AOC representative.

2.3. ACCESS TO AMERITECH FACILITIES

2.3.1. PREMISES ACCESS

The AOC will allow the Supplier access to the premises only as required in the performance of job-related activities. Hours of access for the actual installation activity will be agreed to and documented in the Job Coordination Committee meeting minutes.

2.4. FACILITY ACCESS

2.4.1. ACCESS TO FACILITIES

The AOC shall permit Supplier reasonable use of such portions of the existing plant or equipment as are necessary for the proper completion of such tests which require coordination with existing facilities.

2.5. USE OF AVAILABLE TESTING EQUIPMENT

2.5.1. USE OF TEST SETS

The AOC shall allow the Supplier to use system integrated test equipment, meters, and transmission measuring circuits that are available and are required to perform the necessary tests for added equipment. Use of AOC equipment by the Supplier shall **not** interfere with maintenance of operating telephone equipment.

2.5.2. TEST SET AVAILABILITY

Supplier shall provide the portable test equipment to perform all tests specified in the Supplier's installation manuals. The Supplier shall also provide any testing or measuring apparatus necessary for the normal installation of the added product. This includes but is not limited to optical time domain reflectometers (OTDRs).

2.5.3. SPECIALIZED TEST EQUIPMENT

Specialized test equipment required due to special tests required by the AOC shall be the responsibility of the AOC to provide.

2.6. SECURITY

2.6.1. SECURITY REGULATIONS

Supplier's personnel shall comply with the AOC security regulations prevailing at job site.

2.6.2. UNAUTHORIZED PERSONNEL

The Supplier must take the necessary steps to prevent unauthorized persons from entering the AOC premises.

2.6.3. PREMISES SECURITY

Whenever the Supplier's personnel are performing work activities in unattended buildings, the premises shall be kept locked at all times.

2.6.4. EQUIPMENT SECURITY

All windows, screens, fences, doors, gates, and other similar equipment shall be in place at all times.

2.6.5. SECURITY DEVICES

Security devices, including but not limited to door alarms and fire alarms, will **not** be disabled without prior approval of the AOC representative. All security devices must be returned to working condition prior to the Supplier leaving the premises for any reason.

2.6.6. IDENTIFICATION TAGS

All Supplier employees are required to wear an AOC-approved identification tag while on telephone company premises.

2.7. BUILDING CONDITIONS

2.7.1. BUILDING ALTERATIONS

Any building construction or alterations within areas requiring Supplier occupancy shall be completed by AOC before the scheduled start of the installation activity. Any exceptions will be agreed to by the Supplier and AOC representative.

2.7.2. WORK AREA CONDITIONS

The AOC shall take actions as necessary to ensure that the work areas are dry, free from dust, and in a condition not potentially damaging to the equipment being installed.

2.7.3. ROOM VENTILATION

The AOC will provide required ventilation for battery rooms and other required areas.

2.7.4. FIRE PROTECTION APPARATUS

The AOC will install the permanent fire protection apparatus and furnish such temporary apparatus as may be necessary for the protection of central office equipment.

2.8. CEILING INSERTS/FASTENING HARDWARE

2.8.1. PROVIDING INSERTS/FASTENING HARDWARE

The AOC will provide ceiling inserts, embedded ceiling channel, or appropriate fastening arrangements as required.

2.9. CLEARING EQUIPMENT FOR MODIFICATIONS

2.9.1. CLEARING WORKING CIRCUITS

The AOC shall remove cross-connections, trunks, and sundry working equipment, and make other arrangements required to permit Supplier to modify existing plant.

2.9.2. MAKING EQUIPMENT BUSY

The telephone company is responsible to "make busy" equipment in a standard manner to allow installation Suppliers access to equipment for modification or rearrangements. If the modification or rearrangement activity includes removal of the standard "make busy" arrangement, the installer shall supplement the "make busy" arrangement in an approved nonstandard manner. This supplemental "make busy" arrangement will not be removed without approval of the telephone company representative. Upon completion of the work activity, the installer will remove all "make busy" arrangements except the standard "make busy" arrangement placed by the telephone company. It is the telephone company’s responsibility to remove these standard "make busy" arrangements when returning equipment to service.

2.9.3. POWER REMOVAL ON EQUIPMENT

The telephone company is responsible for removing power from equipment when necessary to allow installation Suppliers access to equipment for modifications or rearrangements. Normally, telephone company personnel will make the equipment busy, then defuse the equipment. When installation activity is completed, telephone company personnel will re-fuse, test and remove the busy condition.

2.10. CENTRAL OFFICE GROUNDING

2.10.1. GROUND ACCESS

The AOC shall provide access to suitable central office ground.

2.11. AOC CIRCUIT REQUIREMENT

2.11.1. TEST REQUIREMENTS

The AOC shall furnish information covering the proper test and readjust requirements for apparatus and requirements for circuit performance associated with special circuits or standard circuits modified by AOC drawings.

2.11.2. REUSE OF AOC MATERIALS

New or used material furnished by AOC shall be in such condition that it requires no repair and no adjustment or test effort in excess of that normal for new equipment. The AOC is responsible for the proper functioning of such material. The AOC shall provide the necessary wiring configuration and equipment configuration information for Supplier to properly install such materials.

2.12. AC POWER

2.12.1. AC OUTLETS IN WORK AREAS

The AOC will provide AC-powered outlets to work areas within the building.

NOTE: Motor-driven tools and equipment shall **not** be plugged into equipment frame AC outlets.

2.12.2. AC EQUIPMENT NEAR DIGITAL EQUIPMENT

Motor-driven tools (e.g., motors that produce an RF field) will not be used near digital equipment unless a shield has been provided.

2.12.3. HEATING/AIR CONDITIONING

Heat and air conditioning, as required, will be provided by the AOC.

2.12.4. ADJUSTMENT OF HEATING/AIR CONDITIONING BY VENDOR

No adjustments to controls, thermostats, or venting of the heating or cooling plant shall be made by Supplier's personnel.

2.12.5. GENERAL ILLUMINATION

General illumination of work areas will be provided by the AOC.

2.12.6. AC POWER FOR NEW/ADDED EQUIPMENT

The AOC will provide AC electric power from a designated source to a Power Distribution Panel or junction box for use by the installation vendor.

2.12.7. VENDOR PROVIDED TEMPORARY LIGHTING

When temporary lighting is provided by the Supplier, the wiring shall be installed in such a location that it will not create a safety hazard to personnel. The wiring will be in accordance with the NEC article "Temporary Wiring."

2.13. SPACE FOR ADMINISTRATIVE AND OTHER PURPOSES

2.13.1. ADMINISTRATIVE SPACE

The amount of space and the location for administrative and other areas will be a matter of agreement between the Supplier and the AOC representative in advance of the start of installation. If suitable floor space or facilities are not available within the building, the AOC will be responsible for arranging and acquiring the permits for such temporary structures that are needed.

2.13.2. ASSOCIATED FACILITIES

The AOC will be responsible for providing suitable floor space and/or facilities, as mutually agreed upon, for the following:

A. Administrative and luncheon purposes.

B. Space for tools and equipment.

C. Toilet facilities equipped with proper supplies and custodial services (this includes portable facilities as agreed between Supplier and AOC).

D. Emergency eye wash station in power rooms near battery stands.

2.13.3. ADDITIONAL FACILITY REQUIREMENTS

Among other things, the AOC will **not** be responsible for the following:

A. Providing parking facilities for personal or company vehicles.

B. Supplier's or Supplier's employees' possessions.

C. Providing Supplier with telephone service.

D. Mail and/or delivery service arrangements.

2.14. AOC PROPERTY

2.14.1. AOC PROPERTY PROTECTION

Supplier shall take precautions to protect AOC property.

2.14.2. MATERIAL STORAGE

Material shall **not** be stored in such a manner as to exceed the safe floor load of the building.

2.14.3. DAMAGE TO AOC PROPERTY

Floors, walls, and columns must be protected from damage. The type and amount of protection used shall be mutually agreed upon between the AOC representative and Supplier prior to the start of the job (such as during the Job Coordination meeting). The protection used shall consist of fire-retardant materials.

2.14.4. VENDOR RESPONSIBILITY

If the Supplier causes damage to AOC property, the Supplier shall be responsible for all necessary repairs. If the AOC makes the necessary repairs, the Supplier will reimburse the AOC.

2.14.5. AUTHORIZED EQUIPMENT/DEVICES

Unauthorized equipment or devices, such as gas or electric welding or cutting equipment, torches or other open flame devices, internal combustion engine-powered equipment, radios, transmitting equipment, PCS and cellular telephones or cameras, will not be allowed in AOC buildings without permission of the AOC representative.

2.15. BUILDING OPENINGS

2.15.1. MATERIAL DELIVERIES

The AOC will provide suitable openings in buildings to allow material to be placed in position.

2.15.2. CABLE HOLE OPENINGS

The AOC will provide cable holes and ducts for cable and conductors in floors and walls.

2.15.3. APPROVED FIRE-STOP MATERIALS

The Supplier shall be responsible for opening and fire-stopping cable holes accessed by the Supplier during the installation activity. Only Ameritech approved 3M Fire-stop systems will be used. Fire-stopping shall be performed as outlined in the Workmanship Requirements section (Paragraph 5.4) of this manual and as directed in the Job Coordination meeting.

2.16. HOUSEKEEPING

2.16.1. DAILY GENERAL CLEANING

General cleaning of the equipment and storage areas shall be performed by the Supplier daily during the installation.

2.16.2. EQUIPMENT DUST CONTROL

The Supplier shall ensure that prior to being brought into an equipment area, all materials shall be free of dust and foreign substances.

2.16.3. EQUIPMENT STORAGE LOCATION

The Supplier shall **not** locate materials in corridors, stairs, fire exits, doorways, in front of fire extinguishers or AC/DC Power Control Panels, or on or near batteries or battery stands.

2.16.4. SMOKING ON AOC PROPERTY

The Supplier must confine smoking to designated areas.

2.16.5. CLEAN-UP AT END OF JOB

At the completion of a job, the Supplier shall have five working days to accomplish the following:

A. Removal of job-generated debris from job site.

B. Removal of temporary floor, wall and column protection placed by Supplier.

C. Removal of Supplier's installation tools, Supplier's surplus equipment, and all other Supplier property.

2.17. SAFETY RULES

2.17.1. SAFETY RULE ADHERENCE

It shall be the Supplier's responsibility to ensure that its employees adhere to all safety rules and regulations posted on AOC property and as agreed to in the Job Coordination Committee meeting. In addition, all local, state and federal OSHA requirements (for example, eye protection, hard hats, insulation of hand tools used on energized circuits, etc.) shall be followed. Refer to OSHA General Industry Standards, 1910 and 1926.

2.17.2. EVACUATION PROCEDURES

Supplier's personnel must be familiar with building evacuation procedures.

2.17.3. GROUNDING OF CONDUCTIVE APPARATUS

For personnel safety, it is required that all integrated ground plane conductive apparatus located within 6 feet of the isolated ground plane be bonded to the MGB (ground window) as outlined in Section 5 of this document. Since this ground potential difference exists during the construction stage of a project, the bonding of objects within 6 feet of the isolated ground plane equipment shall be in place when power is provided to the isolated ground plane equipment. As additional conductive apparatus is installed to the 6-foot area around the isolated ground plane after power is provided to the equipment, the additional conductive apparatus shall be immediately bonded to the MGB.

2.17.4. FRAME SUPPORT

All frames waiting installation or transportation and not bolted in place shall be supported with an approved supporting strap

2.18. HAZARDOUS MATERIALS

2.18.1. DISMANTLING OR REMOVAL OF EQUIPMENT

On jobs requiring dismantling of equipment or removal of equipment, the Supplier will contact the AOC representative prior to starting any removal work. The AOC representative will determine what, if any, hazardous materials are present and provide instructions to Supplier regarding it.

2.18.2. REPORTING OF HAZARDOUS MATERIALS

If any additional hazardous material is found by the Supplier during the removal activity, it must be reported to the AOC representative before being removed.

2.19. UNPACKING AND STAGING OF MATERIALS

2.19.1. FLOOR SPACE FOR UNPACKING

The AOC will designate floor space, if available, for unpacking of material.

2.19.2. UNPACKING LOCATION

Materials shall **not** be unpacked in rooms which have working equipment without the prior approval of the AOC representative.

2.19.3. DELIVERY OF MATERIALS

No materials will be brought into working equipment areas that will not be used within five (5) days or as mutually agreed with the AOC representative.

2.19.4. STORAGE AREA

If AOC approval is obtained to unpack equipment or store unpacked materials in rooms with working equipment, the **maximum** allowable area that can be used to store combustible materials is 200 square feet. The designated area should not be located under main runs of cable rack, under no circumstances under power cable racks and will be as far as possible from working equipment. The area will be roped off or otherwise designated in a positive manner. The area will not be used as a storage area for refuse. Refuse must be removed from the building daily.

2.19.5. DISPOSAL OF PACKING MATERIALS

Cardboard boxes, cartons, etc., and other packing material shall **not** be crushed, broken or ripped apart, or otherwise dismantled in the equipment room. After removal of the equipment from the carton, the carton will be removed intact from the equipment room for disposal.

2.20. MATERIAL DISPOSITION

2.20.1. FLAMMABLE MATERIALS DISPOSITION

Unless required for possible return of defective material, the Supplier shall ensure that all extraneous flammable materials such as waste paper, foam plastic, cloth bags, packing boxes, packing material, and similar materials supplied during the installation, be removed from the building on a daily basis (more frequently if any accumulation of such materials creates a potential fire hazard). In addition, the Supplier shall ensure that any such materials removed from the building do not create a hazardous or unsightly appearance to the areas surrounding the

building. Any packing material kept **must** be stored in such a manner as to **not** create a safety or fire hazard.

2.20.2. OTHER MATERIAL DISPOSITION

With the exception of material identified in paragraph 2.19, the AOC representative shall be responsible for determining disposition of all other AOC-owned material.

2.21. ELECTROSTATIC DISCHARGE (ESD) PROTECTION

2.21.1. ESD PRECAUTIONS

The Supplier shall take precautions to protect against equipment failures caused by ESD.

2.21.2. AOC ESD PROTECTION PROCEDURES

The Supplier shall observe the AOC's ESD prevention procedures outlined by the AOC representative in the Job Coordination Committee meeting. All personnel shall maintain a static-safe environment for the handling of plug-in circuit packs and other electronic equipment as recommended by the Ameritech ESD Control Committee. All static generating materials (uncontrolled chairs, Styrofoam containers, untreated plastics and field producing devices such as computer display screens) and personnel not involved in the installation or removal of the circuit pack must be kept at least three feet away from a circuit pack handled outside of its protective packaging.

2.21.3. CIRCUIT PACK PROTECTION

All circuit packs (even those presumed defective) shall be handled in accordance with all ESD protective procedures, carefully packaged and transported in approved protective anti-static and static dissipative packaging.

2.21.4. WRIST STRAP USAGE

All personnel handling bare circuit packs shall wear an approved wrist strap that has been tested before being used the first time during the work shift to ensure its operability.

2.21.5. METAL CABINETS FOR PLUG-INS

All metal cabinets and shelving used to store circuit cards shall be grounded to provide a path for draining static charges. Each of these Plug-In Equipment (PIE) cabinets shall be individually grounded to the CO ground system with a minimum #6 AWG stranded copper wire with proper connectors. Daisy chaining of the cabinets is not allowed.

2.21.6. CIRCUIT PACKS IN METAL CABINETS

All circuit packs shall be kept in their original ESD-protective containers to protect them from ESD and physical damage no matter what kind of cabinet they will be stored in.

2.21.7. BELLCORE ESD REQUIREMENTS

All ESD-protective containers must meet the ESD requirements specified in Bellcore GR-1421-core "Generic Requirements for ESD-protective Circuit Pack Containers," Issue 2, June 1995.

2.22. REMOVAL CONSIDERATIONS

2.22.1. REMOVAL REQUIREMENTS

Although all requirements in this document apply to removals, the following are additional considerations:

A. Where lighting fixtures are part of the removal, temporary lighting will be provided as specified in the Telephone Equipment Order.

B. All floor obstructions including bolts and equipment mounting attachments, which are exposed as a result of the removal effort, shall be removed by the Supplier.

C. Dust-proof partitions will be provided as detailed in the Telephone Equipment Order. Additional fire extinguishers will be provided in partitioned areas by the AOCs as determined at the Job Coordination meeting.

D. Scrap containers will be supplied as detailed in the Telephone Equipment Order. Scrap containers shall **not** be allowed to block equipment aisles, fire doors, fire extinguishers, fire hoses, access to working equipment or work areas, and shall **not** be allowed to present any safety hazard to personnel or working equipment. Scrap containers must not be used as trash containers.

E. Equipment to be relocated/removed shall be temporarily pre-labeled with brightly colored markings (point or permanent markings excluded) identifying equipment/piece parts, etc., being relocated/removed.

F. Existing equipment must be protected from physical damage during the removal activity. The protection used shall consist of fire-retardant materials.

G. All designations on equipment remaining in an office that are associated with removed equipment shall be removed. This includes, but is not limited to, distributing frames, end guards, fuse and power board assignments, and DSX panels.

2.22.2. DISCONNECTS

A. The AOC shall defuse all DC power supplied to all equipment to be removed. This will be done prior to the start of removal.

B. All commercial AC power cable to the frame base outlets and aisle lights shall be disconnected by the Supplier and mined back to origin, i.e., ceiling box, breaker box, etc.

C. Cross-connects, patch cords, plug-in equipment, etc., shall be removed as detailed in the Telephone Equipment Order.

2.22.3. CABLE HOLES

Cable holes shall be closed as detailed in Section 5 of this document. Permanent closures of abandoned cable holes shall be as detailed in the Telephone Equipment Order.

2.22.4. CABLE MINING

Cable Mining is defined as the removal of non-working cable (power, switchboard, armored, etc.) from cable racks (vertical or horizontal) that is mixed with working cables on the same rack. Because this activity imposes dangerous conditions in the Central Office, extreme care must be taken by the removal vendor. The following outlines the minimum requirements for this undertaking. More stringent requirements may be imposed by each specific order. All the requirements will be thoroughly reviewed during the Job Coordination meeting.

A. Switchboard-type cable shall be cut initially as close to the termination of the cable at the equipment or frame as possible and mined toward its source.

B. Power cable shall be removed initially between the source protection device and the cable rack before power cable mining starts.

C. No cable shall be cut any closer than 15 inches from the cable rack, with the hanging loose end visible.

D. Cable cutters shall be equipped with rings to prevent cutting cables without an identified end.

E. No metal tools will be used for lifting, wedging or separating any cables during the cable mining. Only tools approved by the AOC representative shall be used.

F. Cable mining on vertical cable racks between floors where large cables or large amounts of cables are being removed shall be unsecured and removed no more than one floor at a time to prevent excessive unsecured cable hanging weight.

G. The Supplier shall ensure that remaining cables are placed and secured in accordance with the requirements in this document.

H. Power cables that are not completely removed will have their ends properly insulated per the requirements of Section 5 (Paragraph 5.18.1).

I. All power (AC and DC) and ground cables shall be tested for voltage and current prior to removal.

J. At the minimum, the Supplier will immediately notify the AOC representative of the following job conditions discovered during the mining operation. Additional job conditions to be watchful for which may require installer intervention will be discussed in the Job Coordination meeting. Any job conditions which could lead to a more severe problem must be monitored by the Supplier until the problem is resolved.

- Observation of sparks, flashes, or other signs of arcing.
- Noticing cables that are warm to the touch.
- Location of worn, frayed, or damaged insulation on power cables.
- Location of armored cable discovered during the mining operation.

K. During mining operations, the cable hole must be temporarily fire-stopped in accordance with the requirement of Section 5 - "Cable Holes and Openings." As the cable is removed, the steel plate and intumescent composite board must be adjusted so that the steel plate is never more than a maximum of 3 inches from the cables and the intumescent boards are never more than a maximum of 1/2 inch from the cables. The steel plate and intumescent composite boards may extend beyond the cable hole sheathing when the holes are temporarily fire-stopped.

2.22.5. POWER AND GROUNDS

A. The Supplier shall ensure that all AC outlets in remaining frames are operative and the ACEG (AC equipment ground) is continuous at end of job.

B. The Supplier must ensure that DC ground continuity of all remaining bays is maintained at all times.

C. If batteries are involved in removal, the Supplier shall ensure that vent holes are plugged prior to moving.

2.22.6. RULES FOR REUSE

A. Equipment designated for reuse shall be handled by the Supplier as designated in the Telephone Equipment Order and in a manner that will avoid unnecessary repairs, delays, or expense when reinstalled. All mounting hardware (brackets, nuts, bolts, etc.) shall be packaged and shipped with the unit or frame.

B. The Supplier shall be responsible for packing, crating, and shipping equipment as designated in the Telephone Equipment Order.

2.22.7. SUPPORT

The Supplier is responsible for resupporting ironwork, cable rack, etc., originally supported by the removed equipment, in accordance with the requirements in this document.

2.23. EASEMENTS, PERMITS AND RIGHTS-OF-WAY

2.23.1. SUPPLIER RESPONSIBILITY

Prior to installation start date, the Supplier shall obtain all easements, permits, rights-of-way, and licenses for closing sidewalks, streets, alleys, and highways. Building and construction permits shall be obtained by the AOC.

2.24. INSTALLATION PROCEDURES INVOLVING DRILLING AND CUTTING OF MATERIALS

2.24.1. DRILLING/CUTTING DEBRIS

Installation procedures involving drilling, cutting, filing, etc., of material that causes metallic or nonmetallic debris to be dispersed should not be performed in the network equipment room.

2.24.2. DRILLING/CUTTING IN EQUIPMENT ROOMS

If a separate room is not available, the following requirements shall be followed:

A. The drilling, cutting, etc., shall be performed at a location designated by the AOC representative. This designated location will be determined in the following order:

- Outside the building.

- Off premises (such as at a warehouse or storage trailer).
- Network equipment room at a location more than 10 feet away from any network equipment.
- Network equipment room closer than 10 feet from network equipment with the cutting/drilling area enclosed with a protective dust barrier.

B. The area designated for cutting/drilling must be equipped with floor protection such as fire-retardant fiberboard or other approved material. Debris will be cleaned up at the end of each work operation. An approved vacuum cleaner will be used to clean up areas within 10 feet of any network equipment.

2.24.3. CUTTING/DRILLING IN EQUIPMENT AREAS

Situations will occur when material must be cut/drilled in the network area. This includes floors, walls, ceilings and material that is not easily removable from the network equipment area. Examples of not easily removable material include cable hole sheathing, auxiliary framing, framework uprights, ground bars, etc. It shall be the decision of the AOC representative to determine if the material is removable or not. When this condition occurs, the following requirements shall be followed:

A. Extreme caution must be followed when cutting/drilling in the network equipment. All filings, dust, etc., must be collected during the cutting/drilling operation with an approved vacuum cleaner.

B. When cutting/drilling over equipment is necessary, the installer shall completely cover the equipment with an approved covering from the top of the bay(s) to overlap the floor by a minimum of 6 inches and secure with tape. Airflow blockage and equipment overheating must be taken into consideration when covering the equipment. Precautions must be taken to avoid operating circuit breakers, switches, etc., when placing equipment protection. The area directly underneath the cutting/drilling area will be covered with a tarpaulin (minimum size 10-foot square) positioned and secured to catch and contain all debris. Upon completion of the work operation, the installer shall carefully remove the tarpaulin so all debris is contained within. The bay covering shall be examined prior to its removal and cleaned with an approved vacuum cleaner as necessary to ensure that no debris contaminates the equipment.

C. Detailed methods to protect the network equipment will vary in other cutting/ drilling operations; therefore, the approved protection for each specific application will be determined during the preparation of the MOP.

2.25. VACUUM CLEANERS

2.25.1. VACUUM CLEANER REQUIREMENTS

When it is necessary to use vacuum cleaners in the central office environment, the vacuum cleaner used will conform to the following requirements:

A. Vacuum cleaners shall be equipped with EMI (electromagnetic interference) protection.

B. Vacuum cleaners shall be equipped with high efficiency particle arresting (HEPA) filtration methods. The HEPA filters shall provide a particle collection efficiency of 99.97% or greater for particle size of 0.3 microns or smaller.

C. Hoses and any other vacuum cleaner components which may come in contact with electronic equipment shall be made with insulating material.

2.25.2. VACUUM CLEANER PROCEDURES

When it is necessary to use vacuum cleaners in the central office environment, the following procedures shall be followed:

A. Vacuum cleaners used on isolated ground plane equipment shall use an AC source from the integrated ground plane.

B. Electrostatic discharge (ESD) protection procedures must be followed when vacuuming electronic equipment.

C. Bumping the vacuum cleaner into frames shall be avoided.

D. The secondary air source (exhaust) coming from any vacuum cleaner shall be directed to previously cleaned surfaces. Exhaust air shall **not** hit uncleaned surface where the dirt could be disturbed, dispersing it to previously cleaned areas.

E. When vacuuming on cable racks or other area above frames, the frames shall be covered with ESD-coated sheeting to prevent debris from dropping into the frames.

2.26. SS7 (SIGNALING SYSTEMS 7)

2.26.1. SS7 REFERENCE DOCUMENT

All SS7 links shall be installed and labeled per AM-256-015-950 (Ameritech SS7 Link Diversity Standard).

3. PREVENTION OF SERVICE IMPAIRMENT

3.1. INTRODUCTION

3.1.1. PROCEDURES

This section covers the procedures to be taken to prevent service impairment.

3.1.2. RESPONSIBILITIES

The prevention of service impairment is the joint responsibility of the AOC and the Supplier. Every effort must be made to prevent service impairment.

3.1.3. MOP PREPARATION

A written Method Of Procedure is used to detail the how, what, when, and where installation work is to be performed in order to minimize the possibility of a service impairment.

3.1.4. IMPAIRMENT PROCEDURES

If the Supplier becomes aware of a probable or actual service impairment, the Supplier must immediately notify the job site AOC personnel as identified in the initial Job Coordination meeting.

3.1.5. VENDOR ASSISTANCE DURING IMPAIRMENT

If a service impairment should occur, it is vital that the immediate restoration of working equipment be made. Restoration of service is a joint responsibility of the Supplier and the telephone company. The Supplier shall:

A. Assist the AOC in determining the cause.

B. Repair a condition the Supplier caused or complicated.

C. Cooperate in the follow-up service impairment investigation.

3.1.6. VENDOR INSTALLATION ACTIVITIES

Installation personnel should not climb, stand, or perform any installation or removal activity while on cable racks. If an installation or removal operation cannot be performed from ladders, protection for the cables, such as masonite panels, must be provided. The protection provided must be fire-retardant and of sufficient size and thickness to spread the load of the installer's weight on the cables and prevent damage to sheathing of the top layer of cables.

3.1.7. ENGLISH SPEAKING VENDOR CREW MEMBER

The installation crew must always include at least one member who can speak English fluently. This person must be capable of clearly interpreting instructions to all other members of the installation crew on-site at any given time.

3.2. IDENTIFICATION OF POTENTIAL PROBLEMS

3.2.1. VENDOR ANALYSIS

Prior to starting the physical installation, the Supplier shall perform sufficient analysis of the installation activities to identify potential service-affecting work operations, i.e., connecting new equipment to existing equipment and/or power sources, removing equipment, etc. The AOC representative may require this analysis to include a walk-through of the installation activity location with the Supplier and local telephone company personnel to identify potential service impairment conditions. Special attention shall be given to existing areas that are not in conformance with the most current Ameritech requirements and areas that contain aged equipment and cables. See Section 2.2, "Job Coordination," for additional information.

3.2.2. MOP ITEMS COVERED

The Supplier shall prepare an MOP covering each item identified in 3.2.1.

3.2.3. ADDITIONAL WORK ITEMS

The AOC may request MOPs on additional work operations.

3.2.4. TOOLS/PERSONNEL DURING SERVICE IMPAIRMENT

The availability and location of proper tools and trained personnel shall be predetermined in the event a service impairment results from an installation activity.

3.3. GENERAL METHOD OF PROCEDURE

3.3.1. MOP REQUIREMENT

A written MOP is required whenever installation activity will occur on or near working equipment. Installation activity means adding, removing, modifying, rearranging, etc., telecommunication equipment.

3.3.2. MOP SUBMISSION TIME TABLE

The MOPs shall be prepared by the Supplier, submitted to the AOC for approval ten (10) days prior to the activity (or as mutually agreed), and signed by the Supplier and necessary AOC personnel.

3.3.3. ITEMS COVERED BY MOP

MOPs are written, step-by-step procedures outlining the detailed work operations for a specific portion of the job.

3.3.4. GENERAL/DETAILED MOP

A Method Of Procedure may be a General MOP or a Detailed MOP.

A. A General MOP is issued when the installation activity is general in nature (such as cabling over working equipment), and can be used to formally notify the local AOC personnel of the installation activity. General MOPs include information such as basic service protection precautions, location of fusing for circuitry affected by Supplier's work operations, location and availability of spare fuses, definition of alarm responsibilities, etc.

B. A Detailed MOP is issued when the installation activity is specific, complex or arduous in nature, such as modifications to working equipment, power rearrangements, etc. A Detailed MOP contains all the information found in a General MOP, as well as detailed information such as specific installation steps and their schedule, number and schedule of circuits to be made busy, availability of test equipment, etc.

3.3.5. EQUIPMENT (IN-SERVICE VS. OUT-OF-SERVICE)

Installation activity that will occur on working equipment will be in the service condition state specified by the AOC representative or by personnel designated by the AOC representative.

A. Installation activity on equipment in an "in-service" condition may be acceptable when the installation activity will have no effect on the ability of the equipment to handle telecommunication services.

B. Installation activity on equipment in an "out-of-service" condition is most preferable since it affords the maximum protection to service. The equipment shall be removed from service by the telephone company in accordance with Section 2 requirements under "Clearing Equipment for Modification" and "Removal Considerations."

C. Installation activity on equipment may also be performed on a "temporarily-out-of-service" basis when equipment can only be released by temporary routing, etc., and work can only be performed in small increments.

3.3.6. AOC RESPONSIBILITY FOR MOP PREPARATION

Prior to preparing the MOP, the Supplier and AOC representative should review the record of service indicators for the three months prior to the start of the installation activity. This is to ascertain that equipment has performed satisfactorily prior to the installation activity, and any difficulties encountered after the installation activity were caused by the work performed.

3.4. PREPARATION OF METHOD OF PROCEDURE

3.4.1. JOINT VENDOR/AOC REVIEW

The Supplier will analyze all essential information available for the job and confer with the AOC representative regarding the proposed sequence of work prior to preparing the MOPs.

3.4.2. MOP FORM TO USE

All information will be recorded using the MOP forms as shown in Section 6, Figure 12 , or as designated by the AOC. The necessary information can be classified in three categories: General, Detailed Steps, and Restoration of Service. A verbal MOP is not acceptable.

A. The MOP should contain a general outline of the entire equipment affected, work location(s), major equipment to be added, modified, rearranged, etc., as well as general notes and information as required.

B. The MOP shall list in detail all work to be performed, the equipment involved, circuits affected and Supplier’s tests to be performed before equipment is returned to service. As applicable, the MOP will outline the work to be done in such a manner

as to minimize the effect on a customer's ability to complete calls and associated billing. The sequence and hours of work to be performed will also be detailed.

C. The MOP shall also include restorative information such as number and type of circuits that would be out of service, the location of fuses that could operate if a work error occurred, etc.

3.4.3. MOP INFORMATION FOR INCLUSION

The following shall be mutually understood, agreed upon, and included in the written MOP:

A. The service impairment hazards involved.

B. The installation methods, tools, and test sets required, including safety precautions to be used and any special equipment required for safety.

C. The experience level of the personnel is adequate.

D. The equipment to be protected.

E. The tools to be insulated.

F. The time frame during which various steps of work will be performed.

G. The quantity of equipment which may be removed from service during a period of time.

H. Pre-labeling of equipment/piece parts, etc., being relocated/removed.

I. Procedures to be followed and the tests to be made before equipment is connected to any working equipment. This is particularly important when equipment is being connected to common power supply leads or other common leads that would affect the integrity of other equipment.

J. Steps to be taken by the Supplier before any alarm is disconnected.

K. Procedures to be followed to ensure that the proper fuses are removed.

L. Progress reports required during the work operations.

M. Alternatives in the event of unforeseen delays/problems (i.e., back-out procedures, etc.).

N. Which steps of the work will require the notification, presence, and/or assistance of specific AOC personnel.

O. Applicable tests to be performed. If Supplier documents are referenced in the MOP, the documents must be furnished to the AOC. If Supplier documents are not furnished for any reason (such as proprietary information stipulations, etc.), the pertinent narrative in the Supplier document must be included in the MOP.

P. Identification of safe stopping points if the work will extend beyond a work shift and/or if trouble is encountered with working equipment.

Q. Name, title, location and telephone number of responsible installation and AOC supervisors.

3.4.4. MOP REQUIRED INFORMATION

For each step or group of steps, the following information shall be included in the MOP:

A. The dates work will be performed.

B. Start and complete times.

C. Details of the work operation.

D. Protection required.

E. Special precautions.

F. Safe stopping points.

G. Responsibility (i.e., Supplier, AOC).

3.4.5. MOP DETAILED STEPS

The detailed steps shall follow a logical sequence of the installation activity. The following items shall be considered when developing the sequence of installation activity.

A. Equipment or service that will be required first.

B. The amount of work that can be done and still provide a margin of safety for returning released equipment to service at a specified time.

C. Work that can be done without affecting working equipment.

D. Work that must be done at night or other special hours.

E. Work that must be done on an "in-service" basis.

F. Amount of testing required prior to turning the equipment over for service.

3.4.6. MOP HOURS OF COVERAGE

All work will be done between the hours covered in the MOP. The time of day or night the equipment removed from service must be restored will be mutually agreed upon between the AOC representative and Supplier.

3.4.7. MOP FOR MAINTENANCE WINDOW INSTALLATIONS

Work on common current supplies (such as batteries, fuse panels, power cables, etc.), and switching system's central processors shall be performed when a service-affecting error and restoration would have minimum impact.

3.4.8. MOP TIME FOR INSTALLATION

The MOP shall include and allot sufficient time for testing after the installation activity. If the actual transition or modification work extends beyond the estimated allotment of time, testing shall **not** be compromised to comply with the estimated schedule on the MOP.

3.4.9. SAFETY PRECAUTIONS COVERED BY MOP

In the interest of personnel safety, the MOP shall include provisions to protect installation personnel. These provisions, dependent upon the work operation, shall include:

- Eye protection.
- Hard hats.
- Safety belts when working near open equipment doors above ground level.
- Insulation of tools and other metallic objects when working near live equipment.
- Isolation of work area from other current-carrying areas with rubber sheets, fire retardant fiberboard, etc.
- Requiring a minimum of two installers being present when working in or under extremely hazardous conditions (such as live power equipment).

3.5. APPROVAL OF METHOD OF PROCEDURE

3.5.1. MINIMUM APPROVAL REQUIREMENTS

The minimum approval requirements for the MOP shall be the AOC and Supplier representatives. Under no condition shall work on MOP-type work operations be started before approval of the MOP.

3.5.2. ADDITIONAL APPROVAL LEVELS

The AOC representative will determine the appropriate AOC approval levels and department required for specific installation activity covered by the MOP. The appropriate departmental representatives will ensure that each step of the MOP adequately covers their area of responsibility.

3.5.3. DEVIATION FROM MOP

After the MOP has been approved, there shall be no deviation from the procedures without written approval by the AOC representative.

3.5.4. POSTING OF APPROVED MOP

An approved copy of the MOP shall be available at the job site at all times. An approved copy will also be left behind as part of the job specification documentation as mentioned in par. 4.5.1.

3.6. CHANGES TO A METHOD OF PROCEDURE

3.6.1. REQUIRED CHANGES TO APPROVED MOP

When a change in the MOP is required, the Supplier must immediately stop work associated with the MOP and contact the AOC person assigned to supervise the job as identified in the MOP.

3.6.2. APPROVAL OF CHANGED MOP

Changes to the MOP must be shown on a revised MOP and appropriate approval obtained prior to performing revised work operations.

4. JOB PROGRESS AND ACCEPTANCE

4.1. INSTALLATION START, IN-PROGRESS, JOB COMPLETION, AND JOB ACCEPTANCE

4.1.1. PROCEDURE TO BE FOLLOWED

This section details the installation start, in-progress, job completion, and job acceptance requirements to be followed by the Supplier during the installation activity.

4.1.2. USE OF COMMITTEE FOR COMPLEX INSTALLATIONS

The Supplier may be required to participate on AOC committees necessary for coordinating activities associated with more complex installation undertakings.

4.2. INSTALLATION START NOTIFICATION

4.2.1. REFERRAL TO OTHER AM TR-EEN-000011 SECTIONS

Refer to Section 2.2, "Job Coordination."

4.3. EQUIPMENT DISCONNECTS

4.3.1. FORM TO USE FOR DISCONNECTS

The Supplier shall record on the "Report of Equipment Disconnected from Existing Plant" form (Section 6, Figure 16 or as designated by the AOC) the equipment disconnected from existing plant and forward to the AOC representative. The report will list major components (units, shelves, frames, etc.) that have been disconnected. The report will be prepared monthly during the interval of the job, listing the equipment disconnected (not necessarily removed) from service during the month.

4.4. COMPLETION REPORT AND CERTIFICATION OF ACCEPTANCE

4.4.1. JOB COMPLETION REPORTING

The Supplier will report the completion of a job to the AOC representative on the "Completion Report and Certification of Acceptance" form (Figure 17, Section 6 or as designated by AOC). Advance completion of a portion of the job will also be reported using this form. This form shall be issued no later than ten (10) days after scheduled job completion.

The supplier will also electronically submit a list of jobs that were completed the previous month in the form of an Excel spreadsheet. This report will be submitted to the Quality Coordinator no

later than the fifth business day of each month. Contact the Quality Coordinator listed in the front of this document for proper spreadsheet format.

4.4.2. AOC JOB ACCEPTANCE

The AOC representative will indicate acceptance of the job by completing the acceptance portion of the form and returning one copy to the Supplier.

4.4.3. AOC PROCEDURE FOR NON-ACCEPTANCE

If the AOC representative decides the job is not acceptable, the form will be returned to the Supplier outlining specific reasons for non-acceptance.

4.4.4. MINOR EXCEPTION ITEMS AT JOB COMPLETION

Minor exception items not completed by the completion date shall be listed by the Supplier on the "Completion Report and Certification of Acceptance" form with the approval of the AOC representative. These minor items must be completed by the installer within the agreed upon time interval (usually 30 days) and a new "Completion Report and Certification of Acceptance" form issued upon completion of the minor items.

4.4.5. VENDOR RESPONSIBILITY AT JOB COMPLETION

The acceptance of the job by the AOC representative shall in no way relieve the Supplier of its warranty responsibility.

4.4.6. NOT MEETING COMPLETION DATES

If scheduled advance or main completion dates cannot be met or the AOC representative does not accept the job, the Supplier and AOC representative must renegotiate and document new completion dates using the "Completion Report and Certification of Acceptance" form.

4.4.7. TESTING OF EQUIPMENT AT JOB COMPLETION

The AOC shall be responsible for required through tests, trunk tests and other interoffice tests after Supplier provides its notice of completion or notice of advanced turnover (unless this effort was part of the order).

4.5. DOCUMENTATION

4.5.1. DOCUMENTATION TURNOVER AT JOB COMPLETION

As a condition of job acceptance, the Supplier will coordinate turnover of all applicable documentation with the AOC representative. This will include items such as, but not limited to, the following:

A. Marked prints (i.e., "as installed" office and equipment drawings).

B. Drawings.

C. Wiring lists and job specifications. Job specs shall be left in the designated area and clearly marked for easy identification.

D. Completed initial battery charge reports.

E. Method of procedures (MOP) with electronic approval or signatures.

F. Records (i.e., fuse, milliwatt).

G. Operating instructions.

H. Test summaries and/or test records.

I. Work forms for material disposition.

J. Technical and installation manuals.

K. Practices.

L. Documentation and drawings associated with Change Notices applied.

M. Copy of the final EIU (TIRKS Equipment Inventory Update) as provided to the AOC Engineer.

5. WORKMANSHIP REQUIREMENTS

5.1. INTRODUCTION

5.1.1. INSTALLATION REQUIREMENTS

The workmanship requirements outlined in this section shall be met by the Supplier. These requirements are applicable to all types of telecommunication equipment installations, including

but not limited to switching, transmission, and power products. This document is not necessarily all inclusive and is intended to be used in conjunction with the equipment manufacturer's product-specific installation manuals, product-specific equipment drawings, and other documents attached to or specified in the contract between the Supplier and Ameritech Services or the AOCs. It shall be the Supplier's responsibility to notify the AOC representative of any discrepancies between the manufacturer's installation manuals or drawings and these requirements as soon as a discrepancy becomes apparent. Resolution of any such discrepancy shall be the responsibility of the AOC representative.

5.1.2. AM TR-EEN-000011 AVAILABILITY

The installation vendor will ensure that, at a minimum, one current copy of this document and a current copy of the appropriate AM drawings will be at the installation site during the entire installation period for the installer's use and reference.

5.2. INSTALLER RESPONSIBILITIES

5.2.1. END PRODUCT RESPONSIBILITY

The Supplier's installer is responsible for the end product, and as such the following items shall be corrected by the installer as directed by the AOC representative:

A. Obvious workmanship defects to manufacturing specifications that were done at the factory when the defects are considered to be a safety or service-affecting item which the installer should have discovered during normal verification or test procedures.

B. Broken or damaged equipment.

C. Items missed or ordered in error by the engineer that are required for the proper operation of the product.

D. Vendor Engineering errors.

5.2.2. PRE-EXISTING DEFECT NOTIFICATION

The Supplier's installer is responsible for notifying the AOC representative of any pre-existing defects discovered in an office that will be extended or compounded by the current job which could increase the likelihood of injury to personnel or cause a service impairment.

5.2.3. INSTALLER CAUSED DEFECT CORRECTION

The Supplier's installer shall be responsible for correcting all defects caused to the existing central office equipment as a result of the current installation process.

5.2.4. BLATANT VENDOR DISREGARD TO SERVICE/SAFETY

The Supplier's installer shall **not** engage in any activities or take any actions that may be deemed a blatant disregard for service and/or safety.

5.2.5. FUSE INSTALLATION

The Supplier's installer shall be responsible for installing all fuses to make the equipment operational.

5.3. NATIONAL ELECTRIC CODE

5.3.1. ADHERING TO NATIONAL ELECTRIC CODE

The Supplier shall complete all work operations in compliance with the current National Electric Code (NEC) as applicable. Where local laws or ordinances apply more stringent requirements, the Supplier shall adhere to the local law or ordinance.

5.4. CABLE HOLES AND OPENINGS

5.4.1. VENDOR RESPONSIBILITY FOR CLOSING CABLE HOLES

The Supplier shall be responsible for opening all cable holes and openings as necessary to install or remove the equipment specified in the order. These holes shall be open **only** during the time required to perform cable operations at the hole. The cable holes shall be temporarily closed at the end of each working day or whenever it is anticipated that no additional cable will be run that same day. Cable holes shall be permanently closed at the completion of the job they were opened for. All firestopping shall be in accordance with AM-760-630-410 (Firestopping Installation Requirements for Floors and Fire Barrier Walls). Additionally:

A. The open cable hole shall be roped off and/or a warning sign shall be posted indicating the open cable hole as directed by the AOC representative.

B. A temporary basket or cover (such as one formed from wire cloth) shall be in place to prevent material and tools from falling through the hole.

C. All holes opened by a Supplier shall be tagged indicating the Supplier responsible for opening the hole.

5.4.2. TEMPORARY FLOOR CLOSING

When a cable hole in the floor is to be temporarily closed, the following procedures shall be followed:

A. The top intumescent composite board shall be placed over the hole with the woven wire mesh facing into the hole. A bead of fire stop putty caulk will be placed between the edge of the intumescent composite boards and the cable bundle.

B. The steel top cover shall be replaced over the composite board with a minimum of four screws, bolts, or C-clamps to hold the cover in place.

C. The material used for temporarily closing the hole shall be located at the hole during the cabling operations, so that it will be readily available for temporary closing at the end of the installation activity for the day.

5.4.3. TEMPORARY WALL CLOSINGS

When a cable hole in a wall is to be temporarily closed, the following procedures shall be followed:

A. The intumescent composite board shall be placed over the hole with the woven wire mesh facing into the hole. Each board will be secured with four screws with fender washers; including one in each corner of the board. The maximum space between the screws is 12 inches on center. A bead of fire-stop putty will be placed between the edge of the intumescent composite board and the cable bundle. Only one side of the wall needs to be temporarily fire-stopped.

B. The material used for temporarily closing the hole shall be located at the hole during the cabling operations, so that it will be readily available for temporary closing at the end of the installation activity for the day.

5.4.4. PERMANENT FLOOR CLOSINGS

The Supplier shall be responsible for fire-stopping only cable holes accessed by the Supplier during the installation activity. The following procedures shall be used to permanently fire-stop cable holes in the floor that are equipped with cable sheathing channel. Refer to Section 6, figures 76, 77, and 78.

A. The cables passing through the hole must be as compact as possible. A band around the entire cable mass above and below the cable hole may be employed to meet this requirement. This band may be cord or a plastic cable strap. The use of the plastic cable strap is acceptable under the following conditions:

- The plastic strap used in this application shall be at least 1/4-inch wide, at least 1/16-inch thick, and be of a different color than the cable insulation.

- The cable strap shall only be used with switchboard-type cable.
- The cable strap shall encircle the entire cable bundle and the cable rack stringer of the vertical cable rack. This will compress the cables against the rack rather than the cable hole cover plate. The cable strap shall **not** be placed around the rungs of the cable rack. Refer to Section 6, Figure 78.
- The end of the cable strap will be properly cut off so that the end is flush or below flush with the head of the strap.
- The cable strap shall be removed prior to running additional cables through the hole.

B. A steel ceiling plate is not required. A single intumescent composite board will be installed at the ceiling secured with a minimum of five screws to a modified ceiling plate or stirrup-style supports. (Five stirrup-style supports required for a 1-0 x 2-0 hole, seven supports required for a 2-0 x 2-0 hole. Refer to Section 6, Figure 79.) The composite board will be installed from above with the screw heads inside the cable hole. The composite board will be cut close (1/4-inch minimum to 1/2-inch maximum) to the cable bundle and will be installed so that the woven wire mesh side faces into the cable hole. A 1-inch bead of intumescent moldable putty shall be applied inside the cable hole around the cable bundle and perimeter of the hole.

C. A single intumescent composite board will be installed at the floor. This composite board will be cut close (1/4-inch minimum to 1/2-inch maximum) to the cable bundle and will be installed so that the woven wire mesh side faces into the cable hole. Intumescent material shall entirely surround the composite board mounting holes to provide a complete seal. A layer of fire-stop caulk will be placed between the edge of the intumescent composite board and its mating surface.

D. The steel floor plate will be installed over the intumescent composite sheet. The screws or bolts securing the floor plate will also secure the composite board and must be placed a maximum of eight inches on center. A 1-inch bead of intumescent moldable putty shall be applied completely around the cable bundle.

E. As new cables are added, a 2-inch wide strip of intumescent moldable putty will be placed between the layers of cable as a smoke-stop. The putty will be located at the ceiling and at the floor composite boards. As each new layer of cable is added to the cable pileup, the cables will be pressed into the putty. During the in-

stallation of large size cables, additional putty may be required to ensure the void between the cables is sealed. Refer to Section 6, Figure 80.

F. A label/seal shall be placed over the edge of the fire-stopped cable hole in such a manner that the hole cannot be opened without breaking the seal. The information on the label/seal shall be filled out by the installer. The label/seal may be obtained from the AOC representative (Ameritech form # AM 756) Suppliers may provide their own labels/seals if similar to the Ameritech label as shown in Section 6, Figure 81, with the following information required:

- Supplier name.
- Telephone company order number.
- Date closed.

5.4.5. PERMANENT WALL CLOSINGS

The Supplier shall be responsible for only fire-stopping cable holes accessed by the Supplier during the installation activity. The following procedures shall be used to **permanently** fire-stop cable holes in fire-stop walls. These fire-stopping procedures will be followed on both sides of the wall. Refer to Section 6, Figure 82.

A. The intumescent composite boards shall overlap the edge of the hole by a minimum of 2 inches on all four sides of the cable hole. The boards shall be secured to the wall with mounting screws located 6 inches apart and with one screw in each corner. All screws will be secured into the cable hole casing, wall studs, or headers. Fender washers (1/4-inch x 1 1/4-inch minimum) will be used under all screw/bolt heads.

B. Two pieces of intumescent composite boards are used to close a wall opening. The composite boards will be installed so that the woven wire mesh side faces into the cable hole. The top of the bottom board will be located level with the top of the cable rack. The top intumescent composite board will be cut close (1/4-inch minimum to 1/2-inch maximum) to the cable bundle. A 1-inch bead of intumescent moldable putty shall be applied completely around the cable bundle and all other openings. A layer of fire-stop caulk will be placed between the edge of the intumescent composite board and its mating surface.

C. The opening between the two pieces of intumescent composite boards will be filled with intumescent moldable putty before installing the 2-inch wide metal splice strips to join the two boards. The metal splice strip shall be secured to the composite boards with screws located a maximum of 3 inches apart and on each

corner of the metal strip. Fender washers (1/4-inch x 1 1/4-inch minimum) will be used under all screw/bolt heads.

D. As new cables are added, a 2-inch wide strip of intumescent moldable putty will be placed between the layers of cable as a smoke-stop. The putty will be located at the composite boards on each side of the wall. As each new layer of cable is added to the cable pileup, the cables will be pressed into the putty. During the installation of large size cables, additional putty may be required to ensure the void between the cables is sealed. Refer to Section 6, Figure 80.

E. When the cable rack passing through a cable hole in the wall contains unsecured cables, the cables will be bundled and banded together with cord before entry into the hole and after exiting the hole. The cable should be in bundles approximately 2 to 3 inches in diameter. Refer to Section 6, Figure 83.

F. A label/seal shall be placed over the edge of the fire-stopped cable hole in such a manner that the hole cannot be opened without breaking the seal. The label/seal shall be applied to both sides of the wall. The information on the label/seal shall be filled out by the installer. The label/seal may be obtained from the AOC representative (Ameritech form # AM 756). Suppliers may provide their own labels/seals if similar to the Ameritech labels as shown in Section 6, Figure 81, with the following information required:

- Supplier name.
- Telephone company order number.
- Date closed.

5.4.6. CLOSING OF CABLE SLOTS, SLEEVES OR CONDUITS

The Supplier shall only be responsible for fire-stopping cable openings accessed by the Supplier during the installation activity. Cable openings are defined as cable slots, sleeves or conduit openings containing power, grounding or switchboard cables. These openings are often found under distributing frames and power distribution bays; however, they may be in other areas of the building through either the floor or wall. Generally, they consist of a small amount of cables as compared with a cable hole. The following procedures shall be used to **permanently** fire-stop cable openings. Refer to Section 6, Figure 84.

A. The cables passing through the opening must be as compact as possible. A band around the entire cable mass on both sides of the cable opening may be employed to meet this requirement. This band shall be cord.

B. A 2-inch wide strip of moldable putty will be wrapped around **each** cable going through the opening. There shall be no air gaps between the cables. The cable(s) shall be centered within the hole.

C. Floor openings shall be filled with a maximum of 1 inch of ceramic fiber as a damming material. Damming material is not required if the distance between the cable and the sleeve is 3/4 of an inch or less. Intumescent moldable putty will be applied at the floor level to a depth of 1 inch (minimum). If the opening is over an area that contains batteries, the bottom of the opening shall also be sealed with a minimum of 1 inch of moldable putty.

D. Wall openings shall be filled with a maximum of 1 inch of ceramic fiber as a damming material. Damming material is not required if the distance between the cable and the sleeve is 3/4 of an inch or less. Intumescent moldable putty will be applied on both sides of the wall, flush with the opening to a depth of 1 inch (minimum).

E. All cable openings using non-metallic sleeving must have the appropriate 3M steel collar installed at the ceiling below the cored hole.

5.4.7. MINERAL WOOL BAG PROCEDURES

When an installer encounters a cable hole with mineral wool bags, non-3M fire-stop products or other non-intumescent material and has not been provided intumescent material to properly close the cable hole in accordance with the requirements of this section, it shall be the installer's responsibility to inform the AOC representative to obtain authorization to order the proper material. All holes will be closed with only approved 3M fire-stop systems.

5.5. PRODUCT REQUIREMENTS

5.5.1. APPROVED MANUFACTURER OF NO-OX-ID COMPOUND

The approved anti-corrosive compound referred to hereafter shall be NO-OX-ID "A" Special as manufactured by Sanchem Inc.

5.5.2. APPROVED TYPE OF LACING CORD

The approved cord referred to hereafter for securing cable and wire shall be twine, waxed polyester, 9-ply or equivalent.

5.6. COMMON ITEMS

5.6.1. AUX FRAMING, CABLE RACKS, FRAMES AND OTHER EQUIPMENT

Auxiliary framing, cable racks, frames, relay racks, units, and other equipment shall:

A. Conform to the particular plans (TEO, base drawings, job specifications, equipment and/or assembly drawings) for each installation.

B. Be free from sharp burrs or edges and have all unfinished surfaces painted.

C. Be clean, neat, and presentable.

5.6.2. HARDWARE

Bolts, nuts, and screws shall be tight.

5.6.3. HARDWARE REQUIREMENTS

Threaded Rods, Bolts, or Screws (a) (b) (c)

A. The protrusion of the threaded part shall be no more than an amount equal to the diameter of the bolt, screw, or rod.

EXCEPTION 1: The threaded studs used to anchor frames/bays/cabinets to the floor may exceed this requirement.

EXCEPTION 2: In areas where personnel safety or equipment protection will not be jeopardized by a longer protrusion of the threaded portion of a bolt, screw or rod, the threaded portion of the bolt, screw or rod shall extend for a distance no longer than three times the diameter of the bolt, screw or rod.

B. The length of the threaded part shall **not** be so short that more than one complete turn of the nut thread remains unengaged (under flush by one full thread).

C. Ends of bolts, screws, or threaded rods shall be free of sharp edges.

5.6.4. COTTER PIN INSTALLATION

The tips of all cotter pins must be bent back against the rod or bolt.

5.6.5. SECURING FIBER TAGS

Fiber tags must be secured with cord. Fiber tags with metal rings must have the ring removed.

5.7. AUXILIARY FRAMING

5.7.1. AGREEMENT WITH JOB SPECIFICATIONS

Auxiliary framing shall be located, leveled, aligned and braced per job specifications and drawings.

5.7.2. TREATMENT OF ENDS

Protruding ends shall be closed with end caps or finishing clips.

5.7.3. PROPER SPLICING TECHNIQUES

Splices of horizontal runs must be staggered at alternate runs.

5.7.4. LAST SUPPORT DIMENSION

Horizontal members must not extend more than 30 inches beyond the last support.

5.7.5. AUX BAR SUPPORT DIMENSION

Auxiliary framing bars shall **not** be unsupported for more than 6 feet.

5.8. CABLE RACKS

5.8.1. INSTALLED PER JOB SPECIFICATION

Cable racks shall be located, leveled, aligned and stenciled per job specifications and drawings.

5.8.2. TREATMENT OF ENDS

Protruding ends shall be closed or capped.

5.8.3. SUPPORT DIMENSION

Cable racks shall **not** be unsupported for more than 6 feet.

5.8.4. UNSUPPORTED DIMENSION

Cable racks must be supported within 3 feet of a free end.

5.8.5. ACCEPTABLE SPLICES

No more than one splice shall be placed between any two adjacent points of support on continuous horizontal runs.

5.8.6. MARKING OF FIBER OPTIC CABLE RACKS, DUCTS, TROUGHS

Main runs of fiber-optic cable racks, ducts or troughs shall be stamped or labeled "Fiber-Optic Cables Only" (or similar wording) at 10-foot intervals on both sides of the cable rack, duct or trough. Additionally, each cross aisle cable rack, duct, or trough will be marked on both sides. The markings will be in a contrasting color to the rack, duct or trough with letters sized no less than 5/8 of an inch high. On multi-duct troughs the designations will be at the top of the divider on both sides of the fiber duct.

5.8.7. MARKING OF POWER CABLE RACKS, TROUGHS

Main runs of power cable racks or troughs shall be stamped or labeled "Primary Power Cables Only" or "Secondary Power Cables Only" at 10-foot intervals on both sides of the cable rack or trough. Additionally, each cross-aisle cable rack or trough will be marked on both sides. The markings will be in a contrasting color to the rack or trough and with letters sized no less than 5/8 of an inch.

5.8.8. CABLE RACK ATTACHMENT PROCEDURES

Where cable racks are directly attached to auxiliary framing, both stringers shall be bolted to the framing at each end of a run. At intermediate points, only one bolt is required at each auxiliary framing intersection. The bolts are to be staggered so that adjacent fastenings along the rack can be made on opposite sides of the rack. When short pairs of auxiliary framing are used to support cable rack extending beyond regular framing, or are used for the support of a frame, two bolts shall be used.

5.9. ROLLING LADDERS AND TRACKS

5.9.1. HARDWARE REQUIREMENTS

Hanger rods or bolts used for direct support of ladder track shall be provided with cotter pins or self-locking nuts.

5.9.2. LADDER TRACK STOP BOLT INSTALLATION

Ladder stop bolt and rubber bushings shall be installed on all ladder track ends and shall be equipped with cotter pin or lock nut.

5.9.3. LADDER TRACK STOP BOLT RELOCATION RULES

Ladder track stop bolts shall be placed or relocated to provide accessibility of equipment.

5.9.4. USE OF NON-CREEP HARDWARE

Non-creep bolts shall be installed, burred and staked on all ladder track end supports.

5.9.5. SPLICING OF LADDER TRACK

Ladder track splice screws shall be equipped with washers and burred, staked, or secured with self-locking nut.

5.9.6. USE OF RUBBER END PLUGS

Rubber end plugs shall be installed.

5.9.7. FENDER/WHEEL GUARD USE

Fenders and wheel-guards shall be placed on all ladders where specified.

5.9.8. LADDER BRAKE ADJUSTMENT

Brakes shall be adjusted to ensure proper operation of brake assembly.

5.9.9. BRAKE ROPE ENDS

Brake rope ends shall be trimmed and clamped.

5.9.10. LADDERS TO BE FREE OF EQUIPMENT

Ladders shall run free and clear of equipment.

5.10. CONDUIT AND RACEWAY (ALSO REFER TO PARAGRAPH 5.3)

5.10.1. CONDUIT/RACEWAY PER JOB SPECIFICATIONS

Conduit and raceway shall be run per job drawings, securely fastened, and all unterminated ends closed.

5.10.2. CLOSE UNUSED OPENINGS

Unused openings of boxes and cabinets shall be closed.

5.10.3. PROPER CONDUIT PLACEMENT

Conduit shall be placed so as not to block future cabling, ladders, etc.

5.10.4. CONDUIT IN ISOLATED GROUND PLANES

Conduit, raceway, or ground wire entering the isolated ground plane of an SPCS (Stored Program Control System) office shall be routed through the ground window (within the prescribed 3 feet) and bonded to the main ground bus.

5.10.5. CONDUIT USED FOR ALARM LEADS/LOW VOLTAGE

Continuity of metallic conduit carrying alarm and low voltage lighting control leads shall be broken by an air gap or insulating coupling to maintain the integrity of the isolated ground.

5.10.6. AC OUTLETS

AC Outlets

A. When work is to be performed on AC circuits the associated fuse or circuit breaker must be opened. The fuse or circuit breaker must be tagged or marked to indicate work in progress.

B. AC outlets shall be UL approved and shall be equipped with a continuous AC Equipment Grounding (ACEG) conductor connected to the ground bus in the AC power cabinet. The ACEG conductor will be the same gauge wire as the phase and neutral conductors.

C. Grounding and polarity must be correct and verified.

5.10.7. USE OF BX IN CENTRAL OFFICE

All AC wiring must be enclosed in metal conduit or raceway. Armored cable, flexible conduit (Greenfield), and metal clad cable shall **not** be used.

Exception 1: Nonmetallic sheathed cable (romex) may be used in fully enclosed framework bases, providing the framework base does not include other cables. Where local jurisdictions do not allow the use of romex cables, nonmetallic coated (jacketed), metal clad (Type MC) may be used in fully enclosed framework bases that do not include other cables. All offices in Illinois require the MC jacketed cables for interbay AC wiring in framework bases, except for network style bays with the dedicated raceway assembly. These externally mounted raceways will be wired with three single-conductor THHN/THWN 12-gauge wire.

Exception 2: Flexible cords and cables may be used for:

1. connection of stationary equipment to facilitate their frequent interchange;

2. equipment where the fastening means and mechanical connections are specifically designed to permit ready removal for maintenance and repair and the equipment is intended or identified for flexible cord connections. In these situations, the cord may be in contact, but not intertwined with other wiring and the outlet for the cord will be located in the same frame, bay or cabinet as the cord-equipped device. Extension cords shall **not** be used.

5.10.8. USE OF EMT IN CENTRAL OFFICE

The use of Electrical Metallic Tubing (EMT), commonly referred to as thin wall conduit, is permitted in applications where the EMT will not be subject to physical damage.

5.10.9. USE OF LIQUIDTIGHT IN CENTRAL OFFICE

Liquidtight flexible metal conduit shall **not** be used as a main fixed raceway for power conductors. Its use shall be limited to areas where flexibility of the raceway is required, and to facilitate the making of bends and turns in the raceway in an efficient manner. The total combined length of all liquidtight flexible metal conduit from source to load shall be limited to 6 feet.

5.10.10. PROPER SUPPORT MATERIALS

Conduit shall be supported with material designed for the support of conduit, such as U-bolts, conduit clamps, conduit straps, etc. Hose clamps, cord, tie wraps and other similar material shall **not** be used to support conduit. The following requirements shall apply to the support of conduit:

A. Rigid conduit shall be secured and/or supported at least every 10 feet and will be fastened to a support within 3 feet of each outlet box, junction box, or cabinet.

NOTE: An outlet box which is secured is considered a support.

B. Electrical metallic tubing shall be secured and/or supported at least every 10 feet and will be fastened to a support within 3 feet of each outlet box, junction box, or cabinet.

C. Liquidtight flexible metal conduit shall be secured and fastened to a support within 12 inches on each side of each outlet box, junction box, cabinet or fitting. No support is required when liquidtight flexible metal conduit is installed inside the base angle of frameworks. Three feet of unsupported liquidtight flexible metal conduit from a fitting is acceptable when flexibility of the equipment is necessary or when the liquidtight flexible metal conduit serves lighting fixtures. Cord/tie wrap can be used to hold liquidtight metal conduit in place within a frame (not for support).

5.10.11. AC WIRING REQUIREMENTS

All branch circuit wiring for lighting, equipment outlets and appliance outlets shall be a minimum of No. 12 AWG solid, copper conductor, National Electrical Code type THHN/THWN.

5.11. FRAMES, BAYS, AND UNITS

5.11.1. TEMPORARY RETAINING DEVICES

Temporary retaining devices shall be removed.

5.11.2. PROPER ANCHORING OF FRAMES

Frames shall be supported/anchored in accordance with the following requirements. For the purpose of the frame support requirements, the term "auxiliary framing" refers to the entire mass of overhead steel including channel bars, cable rack, uni-strut, pipe supports, angle iron, etc. All the requirements are based on the assumption that the frames and cabinets are being anchored to concrete floors. If other conditions exist, the AOC representative must be contacted for appropriate requirements. For the following requirements, a frame with two uprights is a single frame; a frame with three uprights is a double frame. A double frame is considered as two frames and the requirements shall apply accordingly. The earthquake zones are as shown in Section 6, Figure 81. The minimum requirements for each earthquake zone are listed below. Refer to Section 6, Figures 85 and 86 for anchor bolt locations described in paragraphs 1 through 6, 9 and 10:

NOTE: Bay Spacers are not to be considered as a top bay support.

Earthquake Zones 0 and 1:

A. Non-freestanding frames - Two 3/8-inch anchor bolts in diagonally opposite corners of the frame base and two supports to the auxiliary framing at the top of the frame.

B. Non-freestanding frames (in a continuous lineup) 7’ and 9’ environment - One 3/8-inch anchor bolt in diagonally opposite corners of the frame base and two top supports to the auxiliary framing at the top of the frame. NOTE: Bolting one of the upper corners to the adjacent frame is considered one top support. The 2-inch square junction plates are sufficient for this requirement. Only one fastening to an adjacent frame will be allowed per frame as a top support.) Non-freestanding frames (in a continuous lineup) 11’6" environment - One 3/8-inch anchor bolt in diagonally opposite corners of the frame base and two top supports to the auxiliary framing at the top of the frame. Two top supports to auxiliary framing will be re-

quired on 7', 9' and 11'6" frames equipped with spacers in between. The 2" junction plates do not constitute a top support.

C. Floor-supported frames or freestanding cabinets (isolated) - Two 3/8-inch anchor bolts in diagonally opposite corners of the frame/cabinet base.

D. Floor-supported frames or freestanding cabinets (in a continuous lineup) - One 3/8-inch anchor bolt in the diagonally opposite corner from the adjacent frame/cabinet. The frames/cabinets must be bolted together at the top and bottom of each framework upright.

Earthquake Zone 2:

E. Non-freestanding frames (isolated or end frame of a lineup) - Two 3/8-inch anchor bolts in diagonally opposite corners of the frame base and two supports to the auxiliary framing at the top of the frame.

NOTE: Bolting the top of the frame to the adjacent frame is considered one top support.

F. Non-freestanding frames (in a continuous lineup) - One 3/8-inch anchor bolt in the diagonally opposite corner from the adjacent frame. The top of the frame shall be supported at two locations.

NOTE: Bolting the top of the frame to the adjacent frame is considered one top support.

G. Floor-supported frames or freestanding cabinets (isolated or end frame/cabinet in a lineup) - Four 3/8-inch anchor bolts, one in each corner of the frame/cabinet base.

H. Floor-supported frames or freestanding cabinets (in a continuous lineup) - Four 3/8-inch anchor bolts, one in each corner of the frame/cabinet base. The frames/cabinets must be bolted together at the top and bottom of each upright.

Earthquake Zone 3:

I. Non-freestanding frames (isolated or end frame of a lineup) - Two 3/8-inch anchor bolts in diagonally opposite corners of the frame base and two supports to the auxiliary framing at the top of the frame. The top supports in this earthquake zone are more stringent and are unique for each type of frame. Specific requirements shall be obtained from the AOC representative or standard drawings.

J. Non-freestanding frames (in a continuous lineup) - One 3/8-inch anchor bolt in the diagonally opposite corner from the adjacent frame. The top of the frame shall be supported at two locations. The top supports in this earthquake zone are more stringent and are unique for each type of frame. Specific requirements shall be obtained from the AOC representative or standard drawings.

K. Floor-supported frames or freestanding cabinets (isolated or end frame/cabinet in a lineup) - Four 1/2-inch anchor bolts, one in each corner of the frame/cabinet base. Cross aisle or via cable racks shall **not** exceed 5 feet in length.

L. Floor-supported frames or freestanding cabinets (in a continuous lineup) - Four 1/2-inch anchor bolts, one in each corner of the cabinet base. The frames/cabinets must be bolted together upright at the top and bottom of each framework. Cross aisle or via cable racks shall **not** exceed 5 feet in length.

5.11.3. PROPER ANCHORING FOR POWER FRAMES

Power distribution cabinets, floor mounted rectifier bays, and other power frames shall be bolted together in a lineup. Each frame/cabinet/bay will be secured to the floor with two anchor bolts in diagonally opposite corners and will be secured to overhead auxiliary framing. If these requirements cannot be met, the power bays in a lineup will be considered a solitary power cabinet. Solitary or stand alone power cabinets shall be secured to the floor with four anchor bolts. Anchor bolts will be minimum size of 3/8 inch in earthquake zones 0, 1, and 2 and will be a minimum size of 1/2 inch in earthquake zone 3.

5.11.4. ADJACENT FRAMES/BAYS/CABINETS

Adjacent frames, bays and cabinets shall be bolted together.

5.11.5. VERTICAL ALIGNMENT

Vertical alignment of equipment shall be plumb within the allowable deviations in Table 1, Section 6.

5.11.6. END ALIGNMENT OF FRAMES

Joining ends of frames will not be out of alignment (in or out from a straight line extending the full length of the lineup) more than 1/16 of an inch.

5.11.7. MINIMUM EQUIPMENT MOUNTING REQUIREMENTS

All units mounted in frames, cabinets, or bays will have a minimum of four screws used to secure the unit to the frame/cabinet/bay upright.

Exception: Single mounting plate units can be mounted with two screws.

5.11.8. FLOOR VARIATIONS

To compensate for variations in the floor, shims or leveling blocks shall be used to level frames and cabinets. For Zones 0 and 1 and the ground floor in Zone 2, the wedge-type shims may be used. For Zone 3 and the other floors in Zone 2 offices, flat steel plates with a minimum width of 4 inches must be used for shims. All shims should be placed flush with the outside face of the equipment framework. The shims shall **not** protrude into the maintenance or wiring aisles.

5.11.9. EQUIPMENT AND FRAME FOOTPRINT

No part of any frame or apparatus attached to the frame shall extend horizontally beyond the front or rear edge of the base (or guard rail) of the frame foot print.

5.11.10. END GUARDS

End guards must be installed on the first and last frame of each aisle and on all exposed ends not bolted to an adjacent frame.

5.12. CABLE AND WIRE PROTECTION

5.12.1. PROTECTION OF CABLES AND WIRING

All cables and wires shall be protected against damage at all locations where they come in contact with sharp metal edges and where the cables break over the stringer of cable rack. A sharp edge is defined as a right angle metal edge or an edge where the metal has been cut off. Rolled and rounded metal edges do not require protection. When cables do not come in contact with sharp metal edges or cable rack stringers but it is obvious that subsequent cable or other installation activity may force the cable into contact with the edge, protection shall be installed on the metal edge or cable.

A. Primary power conductors shall be protected against damage at all locations where they come in contact with a metal edge (whether sharp or not). Secondary power cables and grounding cables shall follow the same requirements as specified for switchboard cables.

5.12.2. PROTECTION AT SHARP BENDS, EDGES

Wiring shall be protected from hazardous conditions, such as sharp bends over metal edges, screw threads, excessive strain, etc.

5.12.3. PROTECTION OF CABLE ENDS AFTER EQUIPMENT REMOVAL

The ends of switchboard-type cable and wire cut dead as a result of equipment removal do not need to be protected if the cable ends are on the cable rack. If the cable ends cannot be stored on the cable rack, the ends shall be covered with heat shrink.

5.13. CABLING

5.13.1. PROPER CABLE SEGREGATION

The layout of cable racks, the routing of cables, critical lead length and cable segregation requirements shall conform to job specifications and drawings.

5.13.2. CABLE PLACEMENT ON CABLE RACK

Place cable in a manner to ensure cables will remain on cable rack.

5.13.3. CABLE BENDING RADIUS

Manufacturer's minimum radius specifications for bending cable shall **not** be exceeded, and sharp bends in cable shall be avoided.

A. Due to the multitude of switchboard cable sizes, construction, and material composition, the bending radius of switchboard-type cables shall follow the manufacturer's specifications. In the absence of manufacturing specifications, the minimum bending radius along the inside edge of switchboard-type cables shall be twice the diameter of the cable. In no case shall the bend radius be less than 1/2 inch.

B. Refer to Section 6, Table 5 for power cable bending radius requirements.

5.13.4. PLACEMENT TO AVOID PILEUPS AND BLOCKAGE

Cables shall be placed to avoid pileups and blocking of cable runs.

A. The maximum pileup of switchboard-type cables on a horizontal run of ladder-type cable racks is as follows:

	Cable pileup maximum depth on cable racks supported at intervals of:	
Cable rack width	**5 feet or less**	**Between 5 feet and 6 feet**
5-inch	5 inches	5 inches
10-inch	10 inches	10 inches
12-inch	12 inches	12 inches
15-inch	12 inches	10 inches
20-inch	12 inches	10 inches
25-inch	12 inches	10 inches
30-inch	10 inches	7 inches

No cable rack over 30 inches wide shall be used.

B. The maximum pileup of switchboard cables on a horizontal run of bar-type cable racks is equal to the height of the cable rack horn. Tubular extensions to increase the height of the horn are not permitted on straight sections or over frame cable racks. The tubular extensions are allowed on cross aisle cable racks to increase the height of the horn to match the straight section or over frame cable rack horn height.

C. The maximum pileup of other types of cables (such as power cables) is dependent upon the safe load limits of the supporting members of the cable rack. If there is any question that the safe load limitations may be exceeded, the installer shall notify the AOC representative. The determination of the safe load limits will be made using the engineering requirements specified in the Cable Rack section of the Ameritech Central Office Equipment and Engineering Requirements (AM TR-EEN-000015) manual. The following charts may be used as a guideline for horizontal power cable rack runs supported by 5/8-inch threaded rods in inserts pre-cast into the ceiling:

The following charts may be used as a guideline for horizontal power cable rack runs supported by 5/8-inch threaded rods in inserts pre-cast into the ceiling:

When all power cables on the rack are of a uniform size:

Distance between Supports	**Number of Power Cables on 1 15" or 20" Rack**			
	750 MCM	**500 MCM**	**350 MCM**	**4/0**
4' to 5'	74	110	153	225
5'1" to 6'	43	64	89	143

When power cables of different sizes are mixed on the cable rack:

Distance between Supports	Height in Inches of Cable Pileup			
	Cable type RHW		Cable type XHHWL	
4' to 5'	7"	9"	6"	7"
5'1" to 6'	4"	5"	3"	4"

D. The maximum pileup of cables on a vertical cable rack are as follows:

Cable Type	Maximum Pileup
RHW-type power cable	7 inches
XHHW-type power cable	6 inches
Switchboard cable	12 inches

E. The maximum allowable cable fill area of open cable rack systems for No. 1/0 AWG cable or larger shall be as listed in the following table. The chart is applicable to fused and unfused power conductors.

Allowable Cable Rack Fill		
Cable Circular Density (Circular Mills per Amp)	% of Fill (Width)	Number of Layers (No. 1/0 AWG or Larger)
1,200 CM/amp	100	3 or more
1,000 CM/amp	100	2
800 CM/amp	80	1
500 CM/amp	65	1

The following examples can be used to determine the process to follow when using the "Allowable Cable Rack Fill" table.

Example 1

A 200-ampere rectifier is installed with No. 4/0 AWG conductors used as the rectifier charging leads. The rectifier output protection device is 225 amps.

The circular mills of the conductor is divided by the circuit protection device rating or the maximum current that can flow on the conductor. The circular mills of the No. 4/0 AWG conductor is 211,600 cm. Therefore, 211,600 divided by 225 equals 940 circular mills per ampere. In this case **only one layer of cable** can be used and the cables must be secured separately across the cable rack so that 20% of the cable rack is open. The open space shall be evenly distributed between the cables on the rack.

Example 2

A 200-ampere rectifier is installed with 350 MCM conductors used as the rectifier charging leads. The rectifier output protection device is 225 amps.

The circular mills of the conductor is divided by the circuit protection device rating or the maximum current that can flow on the conductor. The circular mills of the 350 MCM conductor is 350,000 cm. Therefore, 350,000 divided by 225 equals 1,556 circular mill per ampere. In this case cables can be piled up to **three layers or more** and 100% of the cable rack used. In this case the weight restrictions specified in Section 5.13.4 (3) would apply to the total amount of layers the power cable can be piled.

Example 3

A 266-ampere distribution circuit fused at 400 amps is provided from the power plant to a BDFB with a 750 MCM cable used to carry the load.

The circular mills of the conductor is divided by the circuit protection device rating or the maximum current that can flow on the conductor. The circular mills of the 750 MCM conductor is 750,000 cm. Therefore, 750,000 divided by 400 equals 1,875 circular mills per ampere. In this case the cables can be piled up to **three layers or more** and 100% of the cable rack used. In this case the weight restrictions specified in Section 5.13.4 (3) would apply to the total amount of layers the power cable can be piled.

5.13.5. CABLE RUNNING TAG REMOVAL

Cable running tags shall be removed upon completion of testing. If local procedures require a cable tag for testing purposes, the paper tag must be replaced by a fire retardant tag.

5.13.6. CABLES DESIGNATED "FUTURE"

All cabling designated "future" shall be stored to allow future access.

5.13.7. CABLE REPLACEMENT (SPLICE QUANTITY RULES)

New cable being installed must be replaced if the number of splices exceeds five percent of the conductors in the cable or form.

5.13.8. POWER CONNECTOR PLACEMENT

Power connectors shall **not** be placed inside power bays, BDFBs or other power distribution bays. These power connections shall be made on the cable rack. Power connections for equipment bay may be made inside the bay or on the rack as space permits. When power connectors (i.e., H-taps, etc.) are placed on cable rack, it shall be placed between the straps of the cable rack. Cables should not be run over power connectors on a cable rack.

Exception: Where H-tap connections are used to facilitate power cable drops into primary power distribution bays, and BDFBs, cables may be run over the connectors.

5.13.9. CABLE PLACEMENT NEAR BUILDING OBSTACLES

Cables shall **not** run over building obstacles (such as water pipes, conduit, air ducts, etc.). When this condition arises, the cable run would be considered blocked until the obstacle is removed or supplementary cable rack is added.

5.13.10. PRIMARY POWER CABLE PLACEMENT (SECONDARY/SWITCHBOARD CABLES)

Primary power cables shall be on different cable racks than switchboard cables. Secondary power cables should not be mixed on the same cable rack with switchboard cables. Primary and secondary power cables shall **not** be on the same racks. Primary power cables are defined as those cables between the source and a power distribution bay (BDFB, BDCBB, PD, etc.). These are cables generally fused at 61 amperes or greater. Secondary power cables are defined as those cables between the power distribution bay (BDFB, BDCBB, PD, etc.) and the load and are generally fused at 60 amperes or less.

Exception: P-wire that is being used for secondary power distribution does not require separation from switchboard cables. To qualify for this exception, this wire shall be no larger than 16-gauge and the load fused at no larger than five amperes.

5.13.11. PLACEMENT OF AC CABLE

All AC conductors carrying a nominal system voltage of 120 volts or more shall **not** be run on cable racks or in cable troughs. This includes, but is not limited to, armored cable, nonmetallic sheathed cable (romex), and flexible conduit (whether liquidtight, nonmetallic or metallic). Cable racking containing armored cable (BX) shall be considered as blocked and shall **not** be used. To unblock the cable rack, the BX must either be removed or both ends must be capped with heat shrink caps which are visible for easy inspection.

5.13.12. CONNECTORIZED CABLE LENGTH RULES

The following requirements concerning cable lengths apply for all types of cable:

A. Cables connectorized on both ends by the factory should not be longer than the measured route of the installed cable. Additionally, these cables shall **not** be longer than 10 percent over the measured length for the route of the installed cable. The maximum additional length shall be 10 feet.

B. Bulk cable and cables formed or connectorized on one end at the factory shall **not** be longer than the measured length for the route of the installed cable.

C. Exceptions to these requirements follow. All slack in cable associated with these exceptions should be stored on engineered racks or supports. The excess cable slack resulting in equipment moved from a temporary location to a permanent location shall be stored or removed as directed by the AOC representative:

- Cables that are required to be a fixed length for the proper operation of the equipment.
- Fiber-optic cables manufactured in standard lengths.
- Cables that are associated with installation of equipment in a temporary location (such as in preparation for a hot slide).

D. In all cases, cable slack shall **not** be stored on or near cable racks over distributing frames or DSX frames.

5.13.13. MAXIMUM SPARE PAIRS

A maximum of 10% unused paired wires shall be allowed in any single cable terminating between equipment locations unless there is potential for growth between those locations. (i.e., equipment bay to DSX, E2A, Dantel, CPM, etc.)

5.14. SECURING SWITCHBOARD-TYPE CABLE

5.14.1. SECURING INTERVALS OF HORIZONTAL/VERTICAL CABLING

Cables and wires not in basket-type cable racks or troughs shall be secured with cord. Cables shall be secured at intervals that do not exceed 3 feet on horizontal runs. On vertical runs, cables shall be secured at every strap or at 20 inch intervals, whichever measures the shortest distance. All cables shall be dressed to avoid congestion, permit accessibility to equipment. Excess cord shall be trimmed to a maximum length of 1/2 inch. Tie wraps shall **not** be used on any type of cable rack or cable trough to secure or band cables.

5.14.2. SUPPORT OF CABLES LEAVING CABLE RACK

Switchboard-type cables and wires leaving cable racks end entering frames or cabinets, or cables transversing one level of horizontal cable rack to another, shall be supported in accordance with the following requirements:

A. Cables and wires entering frames or cabinets shall **not** be unsupported for a distance greater than 3 feet.

B. Cables and wires entering distributing frames shall **not** be unsupported for a distance greater than 3 feet.

C. In a multi-level cable rack application, cables and wires leaving one level of cable rack and entering another level shall **not** be unsupported for a distance greater than 3 feet.

D. Cables and wires shall be banded together between the cable rack and first support in the frame or cabinet when the distance is greater than 1 foot or wherever the cables do not stay in place. One band with cord or tie wrap around the entire bundle is acceptable for this application.

5.14.3. SUPPORT OF CABLES AT DISTRIBUTING FRAMES

Conventional distributing frame cabling shall be secured on transverse arms and at break off points per Section 6, Figures 59 through 67.

A. On the vertical side of the distributing frame, cables shall be secured on the top two transverse arms, then every other arm, and then at the last arm (butt location or break off point to horizontal side).

B. On the horizontal side of the distributing frame, cables shall be secured at three points on the horizontal transverse arms as shown in Section 6, Figure 59. Transverse arms 12 inches long or less require cables to be secured at two points.

C. On the horizontal side of the distributing frame, the cable butt shall be on the right side of the terminal strip (viewed from front) and the wires formed to the left of the butt as shown in Section 6, Figure 63.

5.14.4. RULES FOR ACCEPTABLE USE OF TIE WRAPS

When tie wraps are used in the accepted applications (such as distributing frame transverse arms and within the confines of an equipment frame), the following specific requirements must be met:

A. Tie wrap ends shall be cut to eliminate any protrusion.

B. Sharp edges of tie wraps shall be removed.

C. Tie wrap tension shall **not** be so excessive that conductors may be damaged. Generally the tie wrap should be loose enough to be turned.

D. In all cases the tie wrap head must be positioned to avoid contact with existing cables/wire. When cables/wire are added to a bundle secured with tie wraps, the existing wrap shall be removed and the entire bundle will be secured with a new tie wrap or lacing cord.

E. Tie wraps used on conventional distributing frames shall be installed in accordance with Section 6, Figures 59 through 61 and 65 through 67.

5.14.5. SECURING CABLES AT BUTT LOCATION

All cables and wires must be secured at the first support of frame or bay with cord. All cables shall be secured with cord or tie wrap at the butt location of the cable. The cables shall be secured at all cable brackets provided with the manufacturer's equipment. The cables at these intermediate brackets may be secured with cord or tie wraps. If the butt is not within 1 inch of the cable bracket, it will be banded to the existing cables in the form. If cable is terminated at a point above the top bracket in the bay, the cable can be banded to the other cables at the point of break off. Refer to Section 6, Figure 64 and Figure 68.

5.14.6. LOCKING CONNECTORIZED CABLES SECURELY

The ends of connectorized cables shall be positively secured to the corresponding mate connector or backplane connector. In the event the screw, clip, or other interlocking device designed for the specific connector cannot be used, the male and female ends shall be secured with cord or tie wraps. Connectorized cables (such as with Amphenol connectors) shall **not** be connected together in cable troughs or on cable racks.

5.14.7. RULES FOR STITCHING SWITCHBOARD CABLES

The number of switchboard-type cables and wires secured under one stitch shall be in accordance with the following chart. When securing cables of mixed sizes, use the chart for the largest size cable planned for the stitch to determine the amount of cables to place under the stitch.

Number of Cables per Stitch		
Cable size	**Horizontal cable rack**	**Vertical or inverted cable rack**
Over 1 inch	2	1
Less than 1 inch	6	5
Wire (all sizes)	Any number up to 1-inch diameter bundles	Any number up to 1-inch diameter bundles

5.14.8. USE OF ADHESIVE BACKED TIE BASES

Adhesive-backed tie bases that only rely on the adhesive backing to attach to walls, columns, equipment, auxiliary framing, etc., shall **not** be used to secure cable or wire outside the confines of a frame.

5.14.9. HORNED/PANNED RACK USE

To eliminate the expense of sewing cables to racking, the preferred method of running switchboard cables would be horned and panned racks.

5.15. LIGHT GUIDE AND FIBER OPTIC CABLE

5.15.1. PROTECTION OF FIBER OPTIC CABLE

This type of cable must be installed and protected per the manufacturer's instructions and requirements if more stringent than the following Ameritech requirements.

5.15.2. FIBER OPTIC CABLE BENDING RADIUS REQUIREMENTS

The bending radius of fiber optic cables shall meet the following requirements in common equipment areas (such as toll equipment areas, via racks, and intersystem racks). If a manufacturer's specification allows a less stringent requirement within the confines of the manufacturer's network element (such as an STP, switch, packet switch, etc.), the manufacturer's requirements shall be followed.

A. Single fiber cable (including fiber optic jumpers) shall have a minimum bending radius of 3 inches.

B. Multifiber cables shall have a minimum bending radius of 3 inches.

C. Multifiber ribbon cables shall have a minimum bending radius of 9 inches.

5.15.3. PROPER PLACEMENT OF FIBER OPTIC CABLES

Fiber optic cables shall run on dedicated cable racks, troughs of fiber management systems. Within common equipment areas (including toll equipment area, via racks and intersystem racks), new fiber raceways will be installed using the approved fiber management system. Within switching entities, a separate trough incorporated into manufacturer's designed cable system or separate racking is acceptable. Every effort shall be made to separate and protect fiber optic cables from other type cables (switchboard, copper, etc.) by banding, wrapping or tubing. The following requirements apply to the installation of fiber management systems in the common equipment areas:

A. Solid-walled raceway must be used for horizontal runs. The raceway will be installed with covers where room permits. Covers must face the ceiling and no sideways mounting of raceway is allowed. Auxiliary framing, conduit, cable racks, etc., shall **not** obstruct the opening of the raceway covers.

B. Slotted or solid vertical ducts with covers and appropriate elbow sections will be used on the framework upright between the fiber trough and the equipment break off points. The vertical ducts will be mounted with covers facing the aisle.

C. Split harness protective sheathing or spiral wrap as directed by the AOC representative may be used if necessary to protect individual fibers and maintain minimum bending radius where the fibers enter or exit the fiber ducts or at other locations where the fibers need protection. OFNR and MIC breakout cables need not be protected due to their protective sheath. The fibers protected by spiral wrap will fit loosely in the spiral wrap (no more than half the capacity of the spiral wrap shall be used).

5.15.4. PLACEMENT OF FIBER OPTIC SLACK

Slack in fiber cables must be wrapped on spools provided for this purpose or be otherwise secured to ensure the minimum bending radius requirements are maintained. Slack should not be stored at the fiber distribution (cross-connect) frame end of the fiber cable.

5.15.5. PROPER SUPPORT OF FIBER OPTIC CABLES

When not in a fiber management system, single conductor fiber optic cable shall be secured with plastic tape or loosely tied lacing cord at 20-inch intervals. Tie wraps may be used if the cable is protected with a split harness or equivalent protection. Refer to Section 5.15.3 (3) when spiral wrap is used for fiber protection. Multifiber fiber optic cables in protective sheathing shall follow the securing requirements of switchboard cable when not in a fiber management system. Fiber optic cables do not need to be secured within the fiber management system.

5.15.6. AUTHORIZED PERSONNEL FOR FIBER OPTIC INSTALLATION

Only vendor authorized trained personnel shall be allowed to install, service, or maintain light guide and fiber optic systems.

5.15.7. FIBER OPTIC HAZARD WARNING LABEL

A label reminding personnel of the potential hazards of looking at the optical beam shall be in place at all interconnection points of optical fiber communication systems (transmit and receive connections). The label shall be located in plain view and in close proximity to the fiber optic

connection. In no case shall the label be farther than 4 inches from the connection. The labels shall be similar to the typical labels shown in Section 6, Figure 91. The following additional requirements apply per equipment type:

A. At the optical transmitter, the label shall be placed on the equipment unless the 4-inch distance requirement cannot be met. When the required distance cannot be met, the patch cords must be provided with a label tag. The tag will be the self-sticking type that will wrap around the patch cord and stick to itself to form a flag that will contain the precautionary instructions on both sides of the tag.

B. At the optical receiver, the preferred method is to equip the patch cord with a label tag. The tag will be the self-sticking type that will wrap around the patch cord and stick to itself to form a flag that will contain the precautionary instructions on both sides of the tag. As an alternate, a label may be placed on the equipment within 4 inches of the fiber-optic connection.

C. At the optical cross-connect points which have a multitude of connections (such as at fiber distribution bays or shelves), only the shelf/unit will be labeled. Each connection will **not** be labeled. Depending on the equipment design, the label shall be prominently displayed on each shelf/unit or on unremovable covers. (If covers are designed to be removable, the shelf/unit shall be labeled.) Hinged covers are an acceptable location for mounting of labels. The labels shall be placed so as not to be covered by the fiber patch cords. If connections are accessed from the front and rear, labels shall be on the front and rear of each shelf/unit. Label tags on patch cords shall **not** be used at fiber distribution bays.

5.15.8. FIBER OPTIC CABLE/JUMPER PROTECTION

Fiber optic cables/jumpers shall be secured to the shelf, panel or any support in a manner which protects them from damage.

5.16. SHIELDED CABLE

5.16.1. BONDING/GROUNDING OF SHIELDED CABLING

Shielded cable and wire shall have the shield ground bonded at one end only. This bonding will be at the equipment (originating) end unless the product design specifies otherwise.

5.17. SECURING POWER AND GROUNDING CABLES

5.17.1. UNSUPPORTED POWER/GROUND CABLE LENGTH

Power and grounding cables leaving cable racks and supports and entering frames, racks, and other equipment shall **not** be unsupported for a distance greater than 3 feet. Cables shall be banded together between the cable rack and first support in the frame or cabinet when the cables do not stay in place. One band with cord around the entire cable bundle is acceptable for this application.

5.17.2. CABLE SECURING RULES

Power and grounding cables shall be secured in accordance with Section 6, Tables 2 and 3.

5.17.3. USE OF LACING CORD TO SECURE CABLES

Power and grounding cables shall be secured with cord. The only application where tie wraps may be used in power-related areas is to band control cables and wires on power bays and for secondary power cables and wires within the confines of an equipment frame/bay.

5.17.4. SECURING CABLES ON HORIZONTAL RUNS

On horizontal cable rack runs, power and grounding cables shall be secured at the cable rack straps before and after each turn. At break off points, power and grounding cables shall be secured at the last cable rack strap prior to the break off point.

5.17.5. MINIMUM CABLE SECURING RULES (HORIZONTAL/VERTICAL)

Power and grounding cable shall be secured with cord at approximately every 9 inches on the vertical and 18 inches on the horizontal when securing them to auxiliary framing or supporting details provided for this purpose. Power cable shall **not** be run on panned or horned racking. Refer to Tables 2 and 3 for securing to cable racks.

5.17.6. USE OF ADHESIVE BACKED TIE BASES

Adhesive-backed tie bases that only rely on the adhesive backing to attach to walls, columns, equipment, auxiliary framing, etc., shall **not** be used by the installer to secure power or grounding cables outside the confines of a frame.

5.17.7. MULTILEVEL POWER CABLE RUNS

In a multilevel power or grounding cable rack application, cables leaving one level of cable rack and entering another shall **not** be unsupported for a distance greater than 3 feet.

5.17.8. VERTICAL POWER CABLE RUNS EXCEEDING 3 FLOORS

Vertical power cable runs shall have a 20-foot horizontal cable run section at intervals not exceeding three floors. Refer to Section 6, Figure 94, for additional detail.

5.18. POWER AND GROUNDING CABLE PROTECTION

5.18.1. PROPER CLOSURE OF AC/DC POWER CABLE ENDS

Exposed ends of DC and AC power and grounding/bonding conductors shall be protected by one of the following methods:

A. With a double insulated heat gun, install a heat shrink end cap.

B. For AC wire ends in junction boxes, fixtures, etc., a wire nut may be used to cover the wire end.

5.18.2. CABLE INSULATION REPAIR PROCEDURES

Damaged insulation on power or grounding/bonding conductors shall be repaired by covering the damaged area with rubber tape (3M Super 33+ Vinyl Electrical tape or equivalent) built up to the equivalent thickness of the insulation.

5.18.3. C-TAP AND H-TAP COVERS

Power and insulated grounding/bonding conductors (where both conductors are insulated) employing C-tap or H-tap compression connectors shall be protected using fire-retardant hard-shell or soft-shell covers. Refer to Section 6, Figure 88.

A. Hard-shell covers have full-length interlocking edges and foam ends similar to Thomas and Betts catalog # HTC500 covers. These covers may be used with no further requirements.

B. Soft-shell covers have two or three locking tabs on one or both sides of the cover and insulating plastic fingers on the ends similar to Thomas and Betts catalog # HT40C covers or Burndy catalog # CFD-FR. Battery connections shall be covered with tape before closing the cover. Plastic, friction or rubber tape may be used in this application.

5.19. BATTERY DISTRIBUTION LEADS

5.19.1. BATTERY/BATTERY RETURN LEADS ARE CONTINUOUS

All battery and battery return leads should be run in continuous lengths.

5.19.2. PROPER USE OF SPLICES (IF NECESSARY)

If necessary, to utilize lengths or wires effectively on long runs, no more than two splices per run may be made. The splices must only be made on horizontal runs where the splice is not stressed. The splices must be made with compression type connectors.

5.20. BONDING AND GROUNDING

5.20.1. PLACEMENT OF BONDING/GROUND CONDUCTORS

Single bonding and grounding conductors must be surface mounted, visible from the floor and kept separate from other cables to facilitate inspections.

A. Bonding and ground conductors may be routed on and secured with cord to separate cable racks or brackets.

B. A single bonding or grounding conductor may be secured to the sides or bottom of cable racks, to the side of auxiliary framing channels, or to other ironwork details with cord. "L"-shaped cable brackets (hangers) or other specifically designed cable support details must be used for additional cables.

C. Conduit shall **not** be used to support any type of conductor.

D. Bonding or grounding conductors may be run inside short runs of nonferrous or nonmetallic conduit to support the conductor over an open area, provide protection in areas where damage may occur, or as a sleeve through floors and walls. When bonding or grounding conductors are routed inside a nonmetallic conduit for support or protection, only one bonding or grounding conductor shall be installed in the conduit. When bonding and grounding conductors are routed through sleeves between floors or walls, multiple bonding and grounding conductors should be installed through one sleeve.

5.20.2. GIRDLING OF SINGLE GROUNDING CONDUCTORS

The following single grounding conductors shall **not** be encircled by a ring of magnetic material (girdled) except as noted in subparagraphs a through e:

- All conductors terminated on the Office Principal Ground Point Bus (OPGPB).
- All conductors terminated on the Cable Entrance Facility Ground Bus (CEFGB).
- All conductors terminated on the Grounding Electrode Bus (GEB).
- All conductors that form a Ring Ground for radio/microwave equipment rooms.
- Vertical Equalizers (or Vertical Risers).
- Horizontal Equalizers (conductors terminated on the CO Ground Bar to which the lineup frame bonding conductors are terminated).
- Conductors between the Main Distributing Frame (MDF) (for this requirement, MDF means all distributing frames equipped with protectors) and the CO Ground Bar, and between the MDF and the ground window.
- Conductor between Ground Window and CO Ground Bar.
- Conductor between Ground Window and the Integrated Ground Collection Bar.

Bonding conductors may be girdled with no restrictions. Typical examples of bonding conductors are:

- Conductors used to connect the individual frameworks to the horizontal equalizer or the ground window (includes the individual No. 6 AWG framework ground conductors and the No. 1/0 AWG framework lineup ground conductors).
- Conductors used to connect the integrated ground apparatus within 6 feet of the isolated ground plane to the ground window (includes the individual No. 6 AWG conductor and the collection cable to the integrated ground collection bar).
- Conductors that bond the conduit and ACEG to the ground window.

The following rules apply to specific installation situations:

A. Cable holes and steel cover plates: Grounding conductors may be installed through cable holes with steel channel sheathing 6 inches high or less without any restrictions. The liners in the hole, the steel cover plate and the intumescent boards do not contribute enough induced voltage to require any restrictions.

B. Cable hole sleeves: Grounding conductors passing through walls or floors should be protected with a sleeve of nonferrous or nonmagnetic material (such as PVC

or aluminum). If conduit of magnetic material is used, it shall extend no farther than 3 inches from the floor, ceiling or wall.

C. Cable support rings: Grounding conductors shall **not** be supported by support rings made of magnetic material that completely surrounds the cable. Use of support rings made from nonmagnetic material is preferred. Steel "J"-shaped hooks and steel support rings with gaps greater than 1/4 inch are acceptable.

D. The perimeter of encircling magnetic material such as cable rack, auxiliary framing, threaded rod, or other supporting details or assemblies around a single grounding conductor must exceed 36 inches. The grounding conductor must not be encircled in this manner at intervals less than 10 feet apart.

E. If building conditions exist where the above requirements cannot be followed and a grounding conductor is encircled by magnetic materials other than described above, the conductor must be bonded to the encircling material at the points where the conductor enters and leaves the encircling material.

5.20.3. INTEGRATED GROUND TREE DESCRIPTION

In the integrated ground plane, the grounding system will consist of a 750 MCM Horizontal Equalizer connected to the CO ground bar, a No. 1/0 AWG lineup framework bonding conductor per lineup connected to the 750 MCM Horizontal Equalizer, and a No. 6 AWG individual framework bonding conductor connected to the No. 1/0 AWG bonding conductor. The No. 6 AWG bonding conductor will connect to all equipment bays, frames, relay racks, cabinets, metal battery stands (connected to stand, not support railings), spare circuit pack cabinets, and, as directed by the AOC representative, other metallic objects.

A. All conductors of the integrated grounding system will use insulated, stranded wire, type RHH/RHW (conductors 350 MCM and larger may be type THH/THW).

B. Bus bars may be used instead of the No. 1/0 AWG lineup framework conductor. The bus bars must have a cross-sectional area of .125 square inch or more (such as 1" x 1/8" or 1/2" x 1/4", etc.). Support pipes shall **not** be used as a bonding conductor.

C. On Power boards with fuses and BDFB frameworks equipped with battery return bars isolated from the framework, the framework will be bonded with a No. 1/0 AWG conductor directly to the horizontal equalizer on the same floor that the PBD or BDFB is located. Refer to Section 6, Figure 45. There will be no direct connection between the battery return bar and the horizontal equalizer.

D. On BDFB frameworks equipped with battery return bars attached to the framework, the return bar will be bonded with a 750 MCM conductor directly to the horizontal equalizer on the same floor that the BDFB is located. Refer to Section 6, Figure 46.

Exception 1: For small offices (under 300 square feet of equipment area), the following requirements apply:

1. The horizontal equalizer may be eliminated or reduced in size to a No. 4/0 AWG at the direction of the AOC representative.

2. One No. 6 AWG conductor will be connected from the ironwork mass (cable rack, auxiliary framing, etc.) over the equipment bays to the CO ground bar.

3. The framework lineup bonding conductors shall be tied together at both ends of the lineup.

Exception 2: In CEVs and huts that contain loop electronics and/or fiber optic equipment, the framework bonding conductor shall be a No. 2 AWG conductor instead of a No. 1/0 AWG.

5.20.4. ISOLATED GROUND SYSTEM DESCRIPTION

Stored Program Control Switching (SPCS) Systems, whether digital or analog, and the minicomputers of an Operational Support System (OSS) require an isolated ground plane system. An isolated ground plane is completely isolated electrically from the central office or building ground system (integrated ground) except for **one and only one point** of connection. This single point of connection and an area within 3 feet in any direction (a sphere with a 3-foot radius) is referred to as the "ground window." Specific requirements are:

A. The bus bar(s) of the ground window shall **not** be mounted on any isolated ground plane frame.

B. When mounting the bus bar(s) of the ground window on a column or wall of a building, the bar(s) shall be mounted on insulators to ensure the bar(s) is insulated from any integrated building steel.

C. The bus bar(s) of the ground window shall **not** be mounted on the aisle side of a column.

D. Whether the ground window is part of the power plant return bus bar or is a separate bar(s), the connections shall be made as close together as possible. The CO ground connection will be made between the isolated ground terminations and the

integrated ground terminations. All integrated ground connections will be made on one side of the CO ground connection, and all isolated ground connections will be made on the other side of the CO ground connection. In addition, the connections shall be made in a specific order or sequence as shown in Section 6, Figures 35 through 40. However, no rearrangement of the bar will be made to meet the sequencing requirement.

E. The ground window shall be clearly identified by stenciling or other means. The bus bar(s) of the ground window shall be stenciled to identify the integrated side and the isolated side.

F. Only one ground window shall be associated with the principal power source serving the isolated ground plane. Two or more sets of isolated ground plane frames sharing the same power source may be served from a single ground window. The ground window should be as close to the isolated ground plane frames as possible. The ground window must be within one floor of the isolated ground plane frames.

G. All conductive materials of the integrated ground plane that passes within three feet of the ground window shall be bonded to the integrated side of the ground window.

5.20.5. ISOLATED/INTEGRATED GROUND PLANE SEPARATION

Electrical separation between members associated with the integrated (building) ground system and members of the SPCS isolated ground system shall be maintained. Members are defined as structural parts of the integrated ground system or structural parts of the isolated ground system. Specific requirements are:

A. Isolated ground frames, cabinets, etc., shall be insulated from the floor or wall.

B. Anchor bolts securing frames, cabinets, etc., to the floor or wall shall be insulated from the isolated ground frame, cabinet, etc.

C. All metallic objects such as conduit, cable rack, and grounding wires associated with the isolated ground plane frames shall be insulated from the integrated ground once these objects have passed through and have been bonded to the main ground bus at the ground window. A minimum of 1 and 1/2 wraps of sheet fiber protection around conduit is required. Tape shall **not** be used for this purpose. The sheet fiber shall extend a minimum of 2 inches on both sides of the conduit clamp. All conduit and AC boxes that are part of the isolated ground plane shall be at least 2-inches from all metallic integrated ground apparatus. If

the 2-inch distance cannot be met, and the possibility exists that the two ground planes can come in contact with each other by movement of one or both ground planes, fiber protection must be installed around the conduit as noted above.

D. To ensure separation, a current reading must be taken on the frame ground conductor to the Ground Window before any work is started. AC or DC current readings higher than 1.0 amp shall be referred to the AOC Engineer for correction.

5.20.6. CONDUCTOR DISTANCE TO ISOLATED GROUND PLANE

The following distance requirements between the CO ground bar, the ground window and the components being grounded are:

A. In an integrated ground plane, the CO ground bar will serve an area of a square superimposed upon a circle whose radius is 100 feet. The farthest component grounded to the CO ground bar shall be no farther than 200 conductor feet from the bar. Refer to Section 6, Figure 43.

B. In an isolated ground plane, the ground window must be within 100 straight line feet of the CO ground bar, and the farthest member of the isolated ground plane must be within 100 straight line feet of the ground window. This requirement applies whether the ground window and the isolated ground plane frames are on the same floor or different floors. In no case, however, shall the farthest member of the isolated ground plane be more than 200 conductor feet from the CO ground bar to which the ground window is referenced. If the ground window is on a different floor than the isolated ground plane, the 200 feet are measured from the farthest frame through the cable hole to the ground window, to the CO ground bar on the same floor as the ground window. Refer to Section 6, Figure 44.

5.20.7. ISOLATED GROUND PLANE METAL PARTS

All metallic parts of the isolated ground planes shall be grounded (through the ground window) so that shock voltages are not transmitted to personnel.

5.20.8. ISOLATED GROUND PLANE SINGLE POINT GROUND

All isolated ground plane switches must employ radially grounded lineups using one of the two methods described. A switch vendor will employ only one of these two methods:

- Each lineup of frames is deliberately isolated from the adjacent lineup so that no loops in the isolated ground plane occur between lineups.

- All the lineups of frames are deliberately connected at many points to the adjacent lineups so that many loops in the isolated ground plane occur between lineups.

A. If the isolated method is used, cross aisle cable racks must have insulators to prevent the incidental connection between the lineups. AC conduit shall **not** be installed between the lineups except at the same end of the aisle that the framework grounding leads feed the aisle.

B. If the interconnected method is used, one deliberate connection with a No. 6 AWG lead must be made at the opposite end of the lineup from the end where the framework grounding leads feed the aisle. Incidental or deliberate connections between the lineups must be made.

5.20.9. GROUND CABLE BENDING RADIUS REQUIREMENTS

The bending radius of grounding and bonding conductors shall be in accordance with the following requirements:

A. The following grounding conductors shall be run in paths that are as direct and straight as possible without any sudden (right angle) changes in direction:

- All conductors terminated on the Office Principal Ground Point Bus (OPGPB).
- All conductors terminated on the Cable Entrance Facility Ground Bus (CEFGB).
- All conductors terminated on the Grounding Electrode Bus (GEB).
- All conductors that form a ring ground for radio/microwave equipment rooms.
- Vertical equalizers (or vertical risers).
- Horizontal equalizers (conductors terminated on the CO ground bar to which the lineup frame bonding conductors are terminated).
- Conductors between the Main Distributing Frame (for this requirement MDF means all distributing frames equipped with protectors) and the CO ground bar, and between the MDF and the ground window.
- Conductor between ground window and CO ground bar.

- Conductor between ground window and the integrated ground collection bar.

When the direction of the conductor must change, it shall be done gradually. The curvature of the turn shall be done in accordance with the following chart. To meet the bending radius requirements, the connection of grounding conductors shall be in such a manner that the "flow" is in the direction of ground (typical example is shown in Section 6, Figure 41).

Grounding Conductor Size	Minimum Bending Radius to Inside Edge
No. 6 AWG to No. 4 AWG	3 inches
No. 2 AWG to No. 1/0 AWG	6 inches
No. 2/0 AWG to 750 MCM	1 foot
Bus bar	No restrictions

B. The bending radius of bonding conductors shall meet or exceed the cable bending radius requirements per Section 6, Table 5. As an aid in identifying the ground source, the connection of bonding conductors should be in such a manner that the "flow" is in the direction of ground. C-tap or H-tap connections used to bond two adjacent frameworks with one conductor to the lineup framework ground conductor is acceptable. See Section 6, Figure 75, for typical configurations of framework bonding. Typical examples of bonding conductors are:

- Conductors used to connect the individual frameworks to the horizontal equalizer or the ground window (includes the individual No. 6 AWG framework ground conductors and the No. 1/0 AWG framework lineup ground conductors).

- Conductors used to connect the integrated ground apparatus within 6 feet of the isolated ground plane to the ground window (includes the individual No. 6 AWG conductor and the collection cable to the integrated ground collection bar).

- Conductors that bond the conduit and ACEG to the ground window.

5.20.10. INSTALLATION OF AC BRANCH CIRCUITS

Specific AC requirements:

A. All AC branch circuits shall be housed in metallic raceways or conduit from source to load. The entire length of the raceway or conduit shall provide a continuous conductive path. Note that in situations where flexible cord is used (refer to Section 5.10.7, Exception 2), the outlet will be considered the load.

B. The AC Equipment Grounding (ACEG) conductor shall be provided in all raceways or conduit housing AC circuits, and shall be continuous from source to load. This conductor shall be insulated and identified with a green color. The continuity of the ACEG from source to last termination shall **not** be broken by the removal of any outlet, etc., throughout the entire circuit.

Exception: Nonmetallic sheathed cables (romex) may be used in fully enclosed framework bases with an uninsulated wire used for the ACEG.

C. The ACEG conductor and the metallic conduit or raceway entering the isolated ground area shall be routed through and bonded to the MGB of the ground window. This bonding conductor shall **not** exceed 3 feet in length. The minimum size of this conductor shall be a No. 6 AWG. See Section 6, Figure 47, for a typical configuration.

D. The ACEG conductor shall be connected to each junction box that the grounding wire passes through or terminates. A junction box refers to a metallic enclosure containing a load device (such as a convenience outlet).

E. The AC-grounded conductor (neutral) shall be bonded at the immediate output of the AC source only. This conductor shall **not** be grounded at any other point along its entire length.

F. All fluorescent type lighting fixtures shall be permanently installed. Chains shall **not** be used to suspend fixtures over any working equipment (administrative areas excluded).

5.20.11. GROUNDING CONDUCTOR REQUIRED CONNECTORS

All grounding and bonding conductors shall be connected by two-hole crimp type (compression) connectors with split lockwashers between the lug and securing nuts (except for the ACEG and paragraph A below). Mechanical connectors, fittings, or connections that depend solely on solder shall **not** be used. The minimum size conductor for bonding or grounding of the grounding system, including framework grounding, shall be a No. 6 AWG. All conductors will employ stranded wire. Bonding conductors used to connect the frameworks together in the isolated ground plane may be bare or insulated. All other conductors will be insulated. The bonding conductor for units or subassemblies mounted in frameworks shall be in accordance

with manufacturing specifications for size and type. The ACEG grounding conductor shall be sized in accordance with the NEC.

A. Grounding of units or subassemblies mounted within a frame may be accomplished by use of a one-hole connector (lockwasher required between lug and bolt head) when using a No. 6 AWG or smaller.

5.20.12. HIGH CURRENT CARRYING CONDUCTORS NEAR ISOLATED GROUND PLANE

The following lightning and fault-carrying conductors shall be routed in order to remain more than 3 feet (horizontally or vertically) from the boundaries of the isolated ground plane equipment cabinets:

A. Grounding wires between ground window and main distributing frame/protector frame.

B. Grounding wires between central office ground bar and main distributing/protector frame.

C. Wave guide and coaxial cables from a tower-mounted antenna.

D. All grounding or grounded conductors associated with radio gear (including shields and outer conductors or coaxial cable).

NOTE: If the ground bars in a or b are located within the isolated ground plane, the grounding conductors shall be routed to remain more than 3 feet over the equipment cabinets.

5.20.13. GROUNDING OF APPARATUS WITHIN 6 FEET OF ISOLATED GROUND PLANE

Integrated ground plane conductive apparatus located within 6 feet of the isolated ground plane shall be bonded to the ground window with a No. 6 AWG cable. Large volume objects that personnel may contact during their normal work activities while still in contact with an isolated ground plane device must be bonded to the ground window. The conductive apparatus that will be bonded are:

- **Equipment frames in the integrated ground plane (transmission equipment)** - If the equipment frames are parallel to the isolated ground plane, one No. 2 AWG or larger conductor is C-tapped or H-tapped to the lineup ground cable over the frames (each frame does not require a separate bond). If the equipment frames are perpendicular to the isolated ground plane, one No. 6 AWG or larger conductor is C-tapped or H-tapped to the lineup ground cable over each lineup of frames that are within 6 feet.

- **Metallic stands, cabinets and desks** - Freestanding items such as metallic stands, desks and cabinets shall **not** require bonding. This also includes small volume items such as wastepaper baskets, chairs, garbage cans, desk lamps and accessories which are considered portable. Cabinets that are anchored to the walls or floor must be bonded. Also, all spare circuit pack cabinets must be bonded.

- **Ironwork** - Auxiliary framing, cable rack, threaded rods, stanchions, cable hole hardware, and other metallic supports and details shall be considered one unit; therefore, only one bond to the ironwork is required. This bond should be in a central location over the switch. In the event that different levels of auxiliary framing or cable rack are not interconnected by threaded rod or other metallic details over the isolated ground plane area, each level will be considered a separate unit and will require individual ironwork bonds.

- **Lighting fixtures that are not part of the isolated ground plane** - The lighting fixtures, including the associated conduit, are considered one unit and, therefore, only one bond to a lighting fixture is required.

- **Air ducts** - When air ducts are separated by nonmetallic fittings, each section of duct must be bonded; otherwise, the entire duct system will be considered one unit and only one bond is required.

- **Metallic raceway or conduit from other systems** - This includes conduit providing AC to building equipment and/or integrated ground equipment areas, and conduit used to run alarm wiring. Each conduit run must be bonded only once. Two-hole grounding lugs must be used by installing the Burndy-type GAR-TC Ground Connector, or installing two conduit clamps (refer to Section 6, Figure 93). If several conduit runs are mechanically connected together, such as at the power distribution cabinet, a conduit box, or via conduit clamps secured to a unistrut support, only the cabinet, box or support requires the bonding connection, not the individual conduit runs.

- **Building fixtures** - This includes large volume objects such as air-conditioning units, AC power distribution cabinets, water coolers, water pipes, radiators, door frames and window frames. Doors and door frames are considered one unit and do not require individual bonds. Pipes shall be grounded per Section 6, Figure 93. Items that are of small volume, not normally touched by personnel, or generally considered portable, do not require bonding. This includes fire extinguishers and holders, light switch and outlet receptacle cover plates, venetian blinds, signs, dropped ceiling supports, etc.

- Based on the specific building configuration, or as directed by the AOC representative, one or a combination of the following methods may be used to accomplish this requirement. For all applications, "daisy chain" connections shall **not** be used.

A. Preferred: A collection bus bar will be used to gather the No. 6 AWG cable from the conductive apparatus. A No. 2 AWG or larger cable will connect the collection bar to the ground window. If several collection bus bars are installed, each collection bus bar may be connected directly to the MGB of the ground window or the collection bus connector cables can be H-tapped together as shown in Section 6, Figure 48.

B. Preferred: A collection cable will be used to collect several No. 6 AWG cables in one general area. The minimum size of the collection cable shall be a No. 2 AWG. Each No. 6 AWG cable will be connected to the No. 2 AWG collection cable using a compression C-tap or H-tap connector. The No. 2 AWG collection cable will be terminated on the collection bus bar.

C. Acceptable: A collection cable will be used to collect several No. 6 AWG cables in one general area. The minimum size of the collection cable shall be a No. 2 AWG. Each No. 6 AWG cable will be connected to the No. 2 AWG collection cable using a compression C-tap or H-tap connector. The No. 2 AWG collection cable will be terminated at the ground window . If several No. 2 AWG collection cables are installed, each collection cable may be connected directly to the MGB of the ground window, or the collection cables can be H-tapped together as shown in Section 6, Figure 49.

D. Minimal: A direct connection of the No. 6 AWG cable will be used between the conductive apparatus and the ground window.

5.20.14. BATTERY RETURN CONDUCTOR REQUIREMENTS

Battery return conductor requirements:

A. The battery return conductor from an isolated ground plane power distribution bay shall **not** be connected to the ground window (unless the ground window is the return bus of the power plant). The lead shall also be insulated from the power distribution bay framework.

B. The battery return conductor for integrated ground plane equipment, which is being powered from the same power plant serving the isolated ground plane equipment and is a multi-grounded system, shall be routed through the ground window (within the prescribed 3 feet) and bonded to the main ground bus. Two

methods may be used to make these connections when the ground window is not collocated with the power plant:

- Preferred: The battery return leads are H-tapped together and one connection is made on the MGB for each return load as shown in Section 6, Figure 50. This bonding lead shall be sized the same as the load cable up to a maximum size of a No. 1/0 AWG.

- Acceptable: The battery return leads are connected directly to the MGB, and another connection is made at the MGB to the load as shown in Section 6, Figure 51.

5.20.15. JOINING/SPLICING OF GROUND CONDUCTORS

Grounding conductors shall be spliced or joined with compression-type H-taps, or by brazing or welding with a fusible metal alloy. Compression-type butt splice connectors are not acceptable for this application. All splices, joints and the free ends of insulated conductors shall be covered with insulated material in accordance with the requirements of this document.

5.20.16. "DO NOT DISCONNECT" TAG PLACEMENT

All grounding conductors terminated at the Office Principal Ground Point Bus, the Cable Entrance Facility Ground Bus, the water pipe, and at all floor CO Ground bus bars (bus bars where the vertical equalizer terminates), shall be equipped with "Do Not Disconnect" tags. A sign at the bus bar/water pipe may be used instead of the tags at the discretion of the AOC representative.

5.20.17. GROUNDING OF OEM EQUIPMENT IN ISOLATED GROUND PLANE

Other equipment manufacturer (OEM) units mounted in frames located in the isolated ground plane should have internal framework grounds separate from all logic and battery return grounds. These units shall be mounted in the frame directly to the framework supports. Some manufacturers will supply a separate framework ground lead to ensure continuity between the unit and the frame; this ground conductor (size and type specified by the manufacturer) shall be connected to the framework. The unit shall be grounded with conductors sized at No. 6 AWG or larger (unless otherwise specified by manufacturer’s specifications). Adapters used between the unit and the framework when the frame is wider than the unit is considered part of the unit and is an acceptable point for grounding. Adapters with one ground conductor may be used with more than one unit. The installer will be responsible to test each OEM unit for separate internal grounds and document the results on form "OEM UNIT AND CHASSIS GROUND TEST" (Section 6, Figure 92) and return to the AOC representative as indicated on the form.

5.20.18. PRINCIPAL POWER PLANT GROUNDING

Framework of a principal power plant not associated with a ground window shall be bonded to the horizontal equalizer or ground bar via the 1/0 aisle feeder. When associated with a ground window, principal power plant framework grounding conductors will be made according to Section 6 figures as follows:

A. When the ground window is **not** collocated with the power plant and the power plant is on different floors, Figure 52 and Figure 56 will be followed.

B. When the ground window is **not** collocated with the power plant and the power plant is on the same floor, Figure 53 and Figure 56 will be followed.

C. When the ground window is collocated with the power plant and the power plant has an insulated return bus, Figure 54 and Figure 57 will be followed.

D. When the ground window is collocated with the power plant and the power plant has a non-insulated return bus, Figure 55 will be followed.

5.20.19. GROUNDING OF MAIN DISTRIBUTION FRAME

When the Main Distributing Frame and Main Ground Bus (MGB) of the ground window are on the same floor, the ground bus of the MDF must be bonded to both the CO ground bar on the floor and to the MGB. For this requirement MDF means all distributing frames equipped with the protectors. Installation Supervisors shall ensure the presence of this conductor when a new isolated ground system (switch, STE, etc.) or MDF is installed.

5.20.20. GREEN COLORED CONDUCTORS FOR GROUND WIRE

Green wire is required to be used for bonding or grounding conductors. In order to accommodate the transition to all green bonding and grounding conductors, the splicing (C or H-tap) of green to existing gray conductors will be allowed.

5.20.21. NON-SWITCHING EQUIPMENT LOGIC GROUNDS

Unless the manufacturers design requires otherwise, all non-switching equipment logic grounds and equalizer grounds shall run directly to the nearest CO ground bar using gray cable.

5.20.22. SWITCHING EQUIPMENT LOGIC GROUNDS

Unless the manufacturers design requires otherwise, switching equipment logic grounds shall be run to the ground window and shall **not** be bonded to the frame ground.

5.21. FANNING AND FORMING

5.21.1. CLARIFICATION OF CONFLICTING REQUIREMENTS

Due to the scope of wiring requirements, any problems encountered in wiring operations not answered by this part or by the job specifications and drawings shall be referred to the AOC representative for clarification.

5.21.2. REMOVAL OF WIRING/VERIFICATION TAGS

All shop wiring and verification tags shall be removed prior to job completion.

5.21.3. USE OF TIE WRAPS ON POWER CABLES

Cable ties may be used in fanning and forming operations. The requirements of Section 5.14.4 shall apply. At power bays, only the control wires within the bay may be secured using tie wraps.

5.21.4. USE OF PROPER SIZED CABLING

All wires shall be of the specified type, color, and gauge.

5.21.5. PROPER INSTALLATION OF POWER CABLING

All wires shall be dressed to avoid congestion, permit accessibility to equipment, and maintain proper clearance between terminals.

5.21.6. PROPER PLACEMENT OF SPARE/UNUSED WIRING

All spare and unused wire shall be placed in fiber tubing and/or secured to existing forms.

5.21.7. SUPPORT OF VERTICAL/HORIZONTAL CABLE FORMS

Vertical and horizontal forms shall be supported and/or secured at intervals of approximately 20 inches.

5.21.8. MAINTAINING PROPER WIRE TWIST

The normal twist of wires (such as tip and ring pairs) shall be left in place between the butt and connection point. Because of various equipment configurations, it may not always be practicable to keep the twist in place to the actual connection point. In these cases, the last twist in the wire should be as close to the connection point as possible or at a point where one of the wires leaves the form.

5.22. FANNED AND LOOSE WIRE FORMS

5.22.1. PROPER USE OF CABLE RINGS

Cable rings are required when loose wires are formed over more than one terminal block.

5.22.2. PROPER SECURING OF LOOSE WIRING

Loose wires not held in place by rings or other similar retaining devices shall be secured at each point of breakout.

5.23. SEWN FORMS

5.23.1. SECURING OF SEWN FORMS

Sewn forms shall be secured to permit access to the equipment.

5.23.2. WIRING ADDED TO EXISTING FORMS

Wiring added to existing forms shall be secured.

5.23.3. REMOVAL OF EXCESS LACING CORD (DIMENSION)

Starting and ending stitches shall be trimmed of excess cord (excess not to exceed maximum of 1/2 inch in length).

5.24. GENERAL CONNECTING METHODS

5.24.1. PROPER USE OF SINGLE CONDUCTOR LUG(S)

Only one lead shall be attached to a punching, lug, or connector that is designed to accommodate one lead.

5.24.2. PROPER USE OF TWO-HOLE LUGS

Any connector drilled with two fastening holes shall be secured using both holes.

5.24.3. PROPER PLACEMENT OF SPLICES

Splices shall **not** be made within conduits.

5.24.4. CONNECTIONS UNDER SINGLE MOUNTING SCREW

Only one connection shall be attached with the same mounting screw or bolt for 16-gauge wire or larger. Two leads (18-gauge or smaller) may be twisted together before attaching to the screw-type terminal. One complete turn around the screw in a clockwise direction is required. The wire shall **not** overlap. Refer to Section 6, Figure 27. Connections for AC power conductors shall follow the NEC requirements.

5.24.5. SPADE/RING TERMINAL MAXIMUM

A maximum of two spade or ring-type terminals will be allowed under a single screw head for conductors 18 AWG or smaller.

5.24.6. PROPER SOLDER SLEEVE USE

When splicing individual leads, only solder sleeve type splicing connectors shall be used.

5.25. MODULAR SPLICING APPARATUS CONNECTIONS

5.25.1. MODULAR SPLICING REQUIREMENTS

Cable may be spliced using modular splicing apparatus such as 3M's MS2 Modules or AT&T's 711 connectors. The splices must be done according to the manufacturer's specification for the product used. The installer shall be fully trained in the proper method of installing the modular splicing apparatus in accordance with the manufacturer's specifications.

5.25.2. APPROVAL OF SPLICING APPARATUS

The use of modular splicing apparatus must be approved by the AOC representative.

5.25.3. MODULAR SPLICING AT DISTRIBUTING FRAME

When modular splicing apparatus is used on a conventional-type distributing frame, the modular splicing apparatus used for half-tapping cable in preparation for a switch cutover shall be located on the transverse arms on the horizontal or vertical side of the distributing frame. Refer to Section 6, Figures 69 and 71.

A. These connections shall be made in an "in-line" method and staggered to reduce congestion at the frame as shown in Section 6, Figures 70 and 71.

B. The entire length of the connection shall be covered with heat shrink tubing from cable butt to cable butt. The heat shrink should cover 2 inches of the cable sheathing. Refer to Section 6, Figures 70 and 71.

5.25.4. MODULAR SPLICING AT COSMIC DISTRIBUTION FRAME

When modular splicing apparatus is used on a COSMIC type distributing frame, the modular splicing apparatus used for half-tapping cable in preparation for a switch cutover shall be located at the rear of the frame behind the terminal strips. Refer to Section 6, Figure 72. Since sufficient space exists, the connection may be made in the "in-line" or "butt-to-butt" configuration. Refer to Section 6, Figure 73.

5.25.5. PROPER REMOVAL OF UNWANTED "LEG"

When using modular splicing apparatus that requires the unwanted leg to be removed by the installer with cutters, the leads will be cut off individually. The leads will be cut off flush with the splicing module and the wire ends protected with specifically designed covers or tape.

5.25.6. MODULAR SPLICE REMOVAL APPROVAL

It is acceptable to install modular splicing apparatus on cable racks at the direction of the AOC representative, under the following conditions:

A. The pileup of the cable and connectors shall **not** exceed cable rack pileup requirements.

B. Parallel overflow racks or perpendicular spur racks shall be provided for the excess pileup.

C. Dedicated splicing racks shall be designated: "Splicing Cable Rack Only."

D. Future cabling shall **not** be run over existing modular splicing apparatus.

E. The entire length of the splice shall be covered from cable butt to cable butt. Heat shrink tubing or specifically designed boots/covers may be used. When heat shrink tubing is used, only 2 to 3 inches of the tubing on each end shall be shrank with heat (both ends shall be sealed). At the AOC representative's request, the ends of the heat shrink may be secured with cord at each end instead of heat shrinking the tubing. When specifically designed boots/covers are used, they will be secured on each end with cord.

F. A fiber tag shall be tied with cord to the cable which will identify the cable/circuit number. The tag shall be located outside of the cover or heat shrink tubing.

5.26. SOLDERED CONNECTIONS

5.26.1. PROPER SOLDERING TECHNIQUE

Soldered connections shall be soldered so as to provide a secure metallic connection between the parts soldered.

5.26.2. PROPER CONNECTION PRIOR TO SOLDERING

A minimum of 1-1/4 turns shall be made on all soldered, wrapped connections.

5.26.3. PROPER SOLDERING OF WIRED TERMINALS

All wired terminals with holes shall have the holes filled with solder.

5.26.4. CLEARANCE BETWEEN SOLDERED CONNECTION AND NEARBY METAL WORK

Minimum clearances between soldered connections and adjacent metal work shall be 1/32 of an inch.

5.26.5. CLEARANCE BETWEEN SOLDERED CONNECTIONS

Minimum clearances between adjacent soldered connections shall be 1/64 of an inch.

5.26.6. SHINER LENGTH RULES

Shiner length between insulation and point of contact with the terminal shall **not** exceed 1/8 of an inch.

5.27. SOLDERLESS AND WIRE-WRAPPED CONNECTIONS

5.27.1. TABLE FOR WIRE-WRAPPED CONNECTIONS

Solderless wire-wrapped connections must conform to Section 6, Figure 18, for the number of wraps and spacing between turns. (All measurements may be gauged by eye.)

A. Space between turns for 20-, 22-, and 24-gauge wire may exceed the .005-inch requirement, providing that four adjacent turns meet the .005-inch spacing. When the space exceeds .010-inch, the wrap count is interrupted. Refer to Section 6, Figure 19: This connection would be acceptable for 20- and 22-gauge wire since four adjacent turns meet the .005-inch spacing and the spacing between five total turns never exceeds .010-inch. This connection would not be acceptable for 24-gauge wire since the spacing between six turns does exceed .010-inch. Refer to

Section 6, Figure 20: This connection would not be acceptable for 20-, 22- or 24-gauge wire since the spacing between four adjacent turns does not meet the .005-inch maximum.

B. Space between turns for 26-gauge wire may exceed the .005-inch requirement providing that six adjacent turns meet the .005-inch spacing. When the space exceeds .010-inch, the wrap count is interrupted. Refer to Section 6, Figures 19 and 20.

C. Space between turns for 28- and 30-gauge wire may exceed the .003-inch requirement, providing that five adjacent turns meet the .003-inch spacing. When the space exceeds the .003-inch, the wrap count is interrupted. Refer to Section 6, Figures 21 and 22.

D. A wire-wrapped lead may be wrapped over the top of previous wraps when the minimum amount of wraps are not affected by the overlap. The wraps that overlapped and the overlapping wraps are not counted as acceptable wraps. Refer to Section 6, Figure 23 : Wraps numbered 1, 2 and 3 are acceptable; wraps 4 and 5 are overlapped and wrap 6 is an overlapping wrap. This connection is not acceptable because only three wraps are acceptable. Refer to Section 6, Figure 24: This connection would be acceptable for a 20- and 22-gauge wire connection since five wraps are not affected by the overwrapping.

E. A bulged turn is the start of an overlap that did not exceed half the circumference of the turn. Only one bulged turn is acceptable in a wire-wrapped connection. Refer to Section 6, Figure 25.

F. Shiner connections are acceptable when the shiner length is 1/8 inch or less. The distance is measured between the last point the bare portion of the wire comes in contact with the terminal and the start of the insulation. Refer to Section 6, Figure 26.

G. Pigtail connections are acceptable when the pigtail end does not exceed 3/32 of an inch. This distance is measured from the last contact of the bare portion of the wire with the terminal. Refer to Section 6, Figure 27.

H. First connections on a terminal shall be placed to the rear of the terminal to allow for other future connections.

5.27.2. UNACCEPTABLE WIRE-WRAPPED CONNECTIONS MUST BE SOLDERED

All 20-, 22-, 24- and 26-gauge connections not meeting the requirements of an acceptable wire-wrapped connection shall be soldered. Defective 28- and 30-gauge connections shall be

removed, the wire re-skinned and a new connection made. If insufficient slack exists to re-skin the wire, the wire may be spliced. Do not solder 28- or 30-gauge connections.

5.27.3. RECONNECTING WIRE-WRAPPED CONNECTIONS

When reconnecting a solderless wire-wrapped connection (20- to 26-gauge only), one of the following requirements apply:

A. Preferred: If length of lead permits, the lead shall be re-skinned and solderless wire-wrapped.

B. Acceptable: The wire shall be re-skinned to provide three new wraps and the connection soldered.

C. Minimal: If sufficient slack is not available, the wire shall be reconnected using the existing helix and soldering.

5.27.4. CLEARANCE BETWEEN WIRE-WRAPPED CONNECTION AND NEARBY METAL WORK

Clearance between connections and adjacent metal work shall be 1/32 of an inch minimum. The wire end projection shall **not** violate the minimum clearance.

5.27.5. CLEARANCE BETWEEN WIRE-WRAPPED CONNECTIONS

Clearances between adjacent connections shall be 1/64 of an inch minimum. The wire end projection shall **not** violate the minimum clearance. Wire wrap terminals on blocks, backplanes, etc. shall be straight and not bent.

5.27.6. INSULATION REQUIREMENTS ON WIRE-WRAPPED CONNECTIONS

Acceptable wire-wrapped connection for 28- and 30-gauge wire must have one full wrap of insulation before the seven wraps of bare wire. Refer to Section 6, Figure 28.

5.27.7. WIRE WRAPS ON PREVIOUSLY SOLDERED TERMINALS

Connections made over previously soldered terminals or on terminals with solder connections shall be soldered.

5.27.8. TOOL SELECTION FOR WIRE-WRAPPED CONNECTIONS

Wire wraps shall be made using the tool sized to the wire gauge.

5.28. POWER AND GROUNDING CONNECTIONS

5.28.1. VERIFYING POWER CONNECTIONS AT JOB COMPLETION

At the completion of the job installation period and before the job is turned over to the AOC, all job and shop-assembled power connections must be verified for compliance to the requirements in this manual.

5.28.2. CONNECTION SURFACE PREPARATION

Contact surfaces shall be clean. Nonconductive coatings (such as paint, lacquer, enamel, etc.) shall be removed from threads and all other contact surfaces to ensure good electrical continuity. An area of unpainted surface will be visible around grounding connections to ensure the nonconductive coating has been removed prior to the connection. The unpainted area will be between 1/8 inch and 1/4 inch in area around the grounding lug. The unpainted area will be coated with the approved anticorrosive compound. Star washers will be allowed between the lug and contact surface on one-hole grounding lugs with conductor size No. 8 AWG and smaller. Under this circumstance, removing paint and application of no-ox is not required. A lockwasher is required between the lug and screw head. Verification of a locking-type washer shall be by visual inspection.

5.28.3. CONTACT SURFACE DESCRIPTION

Contact surfaces shall be flat.

5.28.4. APPLICATION OF ANTICORROSIVE COMPOUND

The cable ends shall be coated with the anticorrosive compound before making the crimp connection. All unplated connectors, braid straps, bus bars, etc., shall be brought to a bright finish and then coated with the anticorrosive compound before they are connected. Application of the anticorrosive compound shall be done in such a manner that it is easily distinguishable from an untreated connection. The anticorrosive compound shall be applied sparingly but with adequate amounts to indicate that the compound has been applied.

5.28.5. TIGHT HARDWARE ON ALL POWER/GROUND CONNECTIONS

All bolts, screws, and nuts securing power and grounding connections to bus bars, frameworks, etc., shall be tight. Pressure or clamping devices shall be tight.

5.28.6. USE OF PALNUTS/LOCKNUTS ON GROUND CONNECTIONS

Palnuts or locknuts must be applied to each bus bar clamp bolt immediately after tightening the regular nuts.

5.28.7. BATTERY LEADS FOR REMOVED EQUIPMENT

Power cable (battery and battery return leads) associated with removed equipment will be removed from the fuse posts and bus bars of Power Boards and Secondary Distribution Bays. The cable shall be cut off at a convenient location and the cable end protected.

5.28.8. MULTIPLE CONNECTORS/SINGLE SET OF HARDWARE

Multiple bonding and grounding connections shall **not** be secured by the same bolt assemblies. Multiple power connections (battery return) on bus bars (or details designed specifically for multiple connections) may be secured by the same bolt assemblies.

5.29. COAXIAL CONNECTIONS

5.29.1. COAXIAL CABLE CONNECTION REQUIREMENTS

All BNC coaxial connections shall be in accordance with approved Ameritech procedures contained in Attachments 1, 2, and 3 within this document (in rear of section 10).

NOTE: The material in attachments 1, 2 and 3 of this document will be removed from the next issue. The materials covered will be reissued under a separate document number. For questions, please contact Sam Pullum on (312) 727–2285.

5.29.2. 734A/735A CABLE AND CONNECTOR REQUIREMENTS

Figure 1 through Figure 8 contains 734A/735A coaxial cable and BNC connector requirements.

5.29.3. VENDOR CERTIFICATION FOR BNC/COAXIAL CABLE INSTALLATION

All vendors performing coaxial cable stripping, soldering and BNC assembly must be certified according to Ameritech procedures before any installation has taken place.

5.29.4. COAXIAL RESTRICTIONS

Single conductor coaxial cables, similar to type 735, shall **not** be run on cable racks.

5.30. COMPRESSION CONNECTIONS

5.30.1. COMPRESSION CONNECTORS

All power/grounding connections/splices shall be made with compression-type (crimp) connectors, H-taps or C-taps (copper only). Crimps of compression connections shall be made in conformance with the manufacturer's requirements pertaining to wire gauge, type of lug and the

tool used. After crimping, all flashes, burrs, or sharp edges resulting from the crimping process must be removed. All compression connectors (for cable sizes No. 1/0 AWG and larger) shall employ hex or circumferential-type crimps, and the crimp shall emboss an indicator of the die used to make the crimp (refer to Section 6, Figure 87). One- or two-hole connectors shall be used in accordance with the following requirements:

A. Two-hole crimped connectors shall be used for all bonding and grounding connections on conductors larger than #8 AWG.

B. Power connections should use a two-hole crimp connector. When the equipment design is such that the use of a two-hole lug is impractical (such as a fuse post), a one-hole lug may be used. However, in these instances the cable shall be secured in such a fashion that the connection will not loosen. This is normally accomplished by forming the cables in a bundle and breaking out individual leads at each connection point. Additionally, a split lockwasher will be used between the power lug and securing unit on BDFB, BDCBB and Power Plant Distribution Bays. This requirement does not apply to the connections made on the posts of batteries.

C. All compression connectors (for cable sizes No. 1/0 AWG and larger) will have an inspection hole between the tang and barrel of the connector. The cable end will be completely inserted into the connector before the crimps are made. (Exception: Connectors used on the posts of batteries will not be equipped with inspection holes.)

5.30.2. COMPRESSION CONNECTOR WITH HEAT SHRINK

Space between wire insulation and body of compression connectors shall be kept to a maximum of 1/8 of an inch.

A. Clear heat shrink tubing (similar Burndy Type HSC-FR VISI-SHRINK) shall be used on cable as a normal method to meet this requirement.

B. Clear heat shrink tubing (similar Burndy Type HSC-FR VISI-SHRINK) shall be used to cover the space between insulation and connector on flex (or superflex) type cables so that the embossed indicator on one crimp is visible.

C. Clear heat shrink tubing (similar Burndy Type HSC-FR VISI-SHRINK) shall be used to cover the entire barrel of the connector and from 1 inch to 3 inches of the cable insulation on connections made on the posts/battery terminal plates of batteries.

5.30.3. MAXIMUM CRIMP LENGTH

Crimps shall **not** extend onto the tang area.

5.31. THREAD-PRESSURE CONNECTIONS

5.31.1. CONNECTIONS SHALL BE TIGHT

Thread-pressure connections shall be tight and not stripped.

5.32. QUICK-CLIP CONNECTING SLOTTED BEAM TYPE

5.32.1. SINGLE WIRE CONNECTION

Only one wire shall be engaged in each terminal.

5.32.2. USE OF TEXTILE INSULATED WIRE

Textile-insulated wire shall **not** be terminated in slotted beam terminals.

5.32.3. USE OF DEFORMED TERMINALS

Conductors shall **not** be engaged in deformed terminals.

5.32.4. USE ONLY NEW TERMINALS

Previously terminated wire ends shall **not** be re-terminated.

5.32.5. WIRE END/ADJACENT METAL PARTS CLEARANCE

Wire ends shall clear adjacent metallic parts by 1/32 of an inch minimum.

5.32.6. WIRE END EXPOSURE LENGTH

Wire ends shall protrude a minimum of 1/16 of an inch beyond edge of terminals.

5.33. POWER EQUIPMENT - GENERAL

5.33.1. DRILLING IN BASEMENT FLOORS/WALLS IN CENTRAL OFFICE

Before drilling into any basement floor or basement wall, it shall be the Supplier's responsibility to determine from the AOC representative whether waterproofing has been provided and, if provided, the special requirements for anchoring equipment.

5.33.2. PROTECTION OF POWER EQUIPMENT AND BUS BARS

Power equipment and bus bars must be protected any time there is installation activity above them.

5.33.3. ALIGNMENT OF CONNECTIONS AT BUS BARS

Power equipment connections to bus bars must be aligned and placed at a level which will allow the bus bars to remain level. Future growth must be considered when applying this requirement.

5.33.4. CONNECTIONS TO PLATED SURFACES

Plated surfaces, such as tin-plated aluminum, silver-plated copper, etc., are plated to prevent oxidation and reduce contact resistance and, therefore, shall never be sanded. If cleaning is required, wipe with a dry cloth. An application of anti-corrosive compound is optional.

5.33.5. CONNECTIONS TO UNPLATED SURFACES

Unplated surfaces, such as aluminum, copper, painted steel, etc., shall be cleaned with fine abrasive paper and coated with a thin film of the approved anticorrosive compound.

5.33.6. SIZING/PAIRING OF PRINCIPAL POWER LEADS

All power feeds (such as -48V and Return) between the principal power source and the power distribution bay and between the distribution bay and the load shall be paired, closely coupled and sized the same. These leads will be run on the same rack along the entire cable route. If multiple battery cables are required for voltage drop reasons, all of the cables shall be the same size and run on the same cable rack with their return leads.

5.33.7. PROTECTION OF REMOTE BATTERY BUS BARS

All remotely located battery bus bars shall be protected by plastic covers or other protective devices specifically designed for this purpose. The cover shall completely enclose the bus bars and power connections. Openings (including those around cables) should not exceed 1/8 of an inch. The cut outs for the cable shall be circular and follow the outline of the cable. Jagged or sharp edges on the cable cut out are unacceptable. For this requirement, "remote" indicates a battery bus bar located outside the area of the power plant.

5.33.8. REUSE OF POWER CABLING

Power cable shall **not** be reused except to facilitate the need to maintain service while repowering equipment from another power source. The length of the reused cable shall **not** exceed 5 feet in length external to the bay.

5.33.9. IDENTIFYING UNFUSED POWER CABLING

Unfused battery leads and their associated return leads, between batteries and rectifiers, shall be run on separate racks. No other cable shall be run on these racks. The racks shall be stamped or labeled "Charge/Discharge Cables Only" at 10-foot intervals on both sides of the cable rack. The markings will be in contrasting color to the rack with letters sized no less than 5/8 of an inch high.

5.34. POWER EQUIPMENT - SPECIFIC PROTECTION REQUIREMENTS

5.34.1. USE OF INSULATED TOOLS FOR POWER CONNECTIONS

When working on or close to live equipment, all metallic tools must be protected with an OSHA approved insulating material to ensure against short circuits.

5.34.2. PROTECTION OF CERTAIN POWER CABLES

Neoprene and nontextile-jacketed rubber power cable shall be protected against contact with sewing cord and conductive material on vertical runs and support locations. The cables will be protected by wrapping the cables with two layers of 1/64-inch sheet fiber (or one layer of 1/32-inch sheet fiber). The fiber will be located centrally under the stitch to prevent the cord from cutting into the insulation. The cables shall be sewn loosely so as to not damage the cables.

5.34.3. PROTECTION OF EXISTING POWER CABLES DURING NEW INSTALLATIONS

When running new power wire or cable, existing wiring and cable must be protected to ensure against friction damage. On installations of large-gauge power wire, the preferred method to protect existing cables is to use cable guide rings at all points where the new cable could contact existing cables.

5.35. HIGH VOLTAGE CIRCUIT REQUIREMENTS (OVER 120 VOLTS AC)

5.35.1. PROPER IDENTIFICATION OF ALL HIGH VOLTAGE CONDUCTORS

Every high voltage circuit conductor installed by the Supplier shall have **each end** identified.

5.35.2. IDENTIFICATION OF HIGH VOLTAGE OUTLET COVERS

High voltage receptacles shall have the receptacle cover plate marked with the appropriate voltage (i.e., 208V AC, 277V AC) and stamped with 3/16-inch characters in bright red indelible ink or paint.

5.36. FUSE PANELS/CIRCUIT BREAKER PANELS

5.36.1. CAPACITY OF FUSES/BREAKERS PER JOB SPECIFICATIONS

Fuses and circuit breakers shall be of the capacity specified in the job specifications and drawings.

5.36.2. USE OF UNPLATED CARTRIDGES AND FUSES

All unplated cartridge and knife-type fuses, fuse ferrules, blades and contact area of their associated clips shall be cleaned and coated with a thin film of the approved anticorrosive compound.

5.36.3. INSTALLATION OF DUMMY FUSES AT VACANT POSITIONS

Dummy fuses shall be installed at all vacant fuse positions.

5.36.4. UNUSED BREAKERS IN "OFF" POSITION

All circuit breakers that are spare, unassigned, or reserved for future equipment shall be in the "off" position.

5.36.5. PROCEDURE FOR UNTERMINATED LEADS

Fuses and circuit breakers shall **not** be installed or activated on unterminated leads (power wire/cable).

5.37. STORAGE BATTERIES (FLOODED CELLS)

5.37.1. SIMILAR CELLS FOR BATTERY STRINGS

Cells in a string shall have the same ampere-hour capacity, the same number of plates, and shall be of the same manufacturer.

5.37.2. CAUTION ABOUT BATTERY GAS BEING EXPLOSIVE

Battery gases, which are more prevalent during and for a short period (normally 48 hours) after changing, are **explosive** . Working on cells during this period shall be avoided.

5.37.3. REMOVAL OF SHIPPING PLUGS FROM BATTERIES

Shipping plugs must be in place when the cell connections and interconnections are made.

5.37.4. PROCEDURE FOR ELECTROLYTE SPILL

Whenever a spill of electrolyte occurs, the Supplier shall:

A. Neutralize any electrolyte contacting the body.

B. Secure medical attention if necessary.

C. Report the incident immediately to the AOC personnel.

D. Confine the electrolyte spill as much as possible.

5.37.5. LIFTING/MOVING INDIVIDUAL CELLS

Cells shall **not** be lifted using the **intercell connectors, cell posts, or covers.**

5.37.6. RETENTION OF INITIAL BATTERY CHARGE REPORT FORM

An Initial Battery Charge Report (Sample Report Figure 29, Section 6, or as designated by AOC) must be maintained on each battery throughout any battery installation.

5.37.7. USE OF PLASTIC/RUBBER SHEETS UNDER BATTERIES

The plastic or rubber sheets required under batteries shall **not** have an adhesive applied.

5.37.8. SPACING BETWEEN ADJACENT BATTERIES

Batteries must not touch each other or adjacent framework. The spacing between cells in a row should be 3/8 inch to 5/8 inch. The spacing between the rows of cells shall be greater than 3/4 inch (3 inches for floor-mounted cells).

5.37.9. INSTALLATION/HANDLING OF INTERCELL CONNECTORS

Battery intercell connectors shall **not** be filed, scraped or sand papered. All intercell connectors must be lead-covered with no exposed copper.

5.37.10. APPLICATION OF ANTICORROSIVE ON BATTERY POST/INTER-CELL CONNECTORS

The approved anticorrosive compound shall be applied to cover all of the battery post, the intercell connector surface in contact with the battery post, and the threads of the bolts securing the intercell connector to the battery post.

5.37.11. BATTERY STAND INSTALLATION REQUIREMENTS

Battery stands shall be supported depending on the type of stand:

- Metal stand with a full-width battery shelf (See Section 5.37.11 (1).
- Metal stand with support rails as the battery shelf (See Section 5.37.11 (2).
- Polyester glass battery stands (See Section 5.37.11 (3).

All three-tier battery stands (all types) must be supported to auxiliary framing installed at right angles to the stand. A minimum of three sets of auxiliary framing must be used - one set near each end and one set in the middle of the stand.

All one-row battery stands (all types) must be secured in accordance with standard drawings. Each support framework of the stand will be secured to the wall or overhead support.

A. Metal stands with a full-width battery shelf shall be supported in accordance with the following chart for the specified earthquake zone:

Earth-quake Zone	**Location**	**2-Tier 1-Row**	**2-Tier 2-Row**	**3-Tier 1-Row**	**3-Tier 2-Row**
0&1	Ground & First Floor	None	None	None	None
	Above First Floor	Overhead	None	Overhead	Overhead
2	Ground & First Floor	Overhead	None	Overhead	Overhead
	Above First Floor	EQ Bracing	EQ Bracing	Do not use	Do not use
3	All Floors	EQ Bracing	EQ Bracing	Do not use	Do not use

Chart Notes:

- "None" indicates that no further support other than those specified in 5.37.11 are required.

- "Overhead" indicates additional overhead bracing is required as specified in standard drawings.

- "EQ Bracing" indicates that additional earthquake bracing for the batteries and stand as well as overhead bracing are required as specified in standard drawings.

- "Do Not Use" indicates the use of this type of stand is not permitted.

B. Metal stands with support rails as the battery shelf shall be supported as follows: All support framework shall be bolted to the floor with two anchor bolts. Additional requirements for the specific earthquake zones are also to be provided in accordance with the following chart:

Metal Battery Stand with Support Rail Shelf Arrangement					
Earthquake Zone	Location	**1-Tier 1,2 or 3 Row**	**2-Tier 1-Row**	**2-Tier 2-Row**	**3-Tier 1-Row**
0	All Floors	None	None	None	None
1	Ground & First Floor	None	None	None	None
	Above First Floor	EQ Type 1	EQ Type 1	EQ Type 1	Do not use
2	All Floors	EQ Type 2	EQ Type 2	EQ Type 2	Do not use
3	All Floors	EQ Type 2	EQ Type 2	EQ Type 2	Do not use

Chart Notes:

- "None" indicates that no further support other than that specified in 5.37.11 and 5.37.11 (2) is required.

- "EQ Type 1" indicates that the addition of shock protection is required. This protection consists of light section steel channels to provide side and end rails which surround the outside of the cells, as well as plastic spacers installed between the cells. This material shall be installed in accordance with standard drawings.

- "EQ Type 2" indicates that the addition of seismic protection is required. This protection replaces the shock protection apparatus with

high-grade steel channels and grade 5 hardware. Additional floor anchors are also required. This material shall be installed in accordance with standard drawings. The minimum clearance between the battery stand and any other object (wall, equipment, other battery stands, etc.) shall be 4 inches. The battery stands shall **not** be butted together in an end-to end or back-to-back arrangement.

- "Do Not Use" indicates that the use of this type of stand is not permitted.

C. Additional support for polyester glass battery stands in the specific earthquake zones shall be provided in accordance with the following chart:

Polyester Glass Battery Stand Arrangement						
Earthquake Zone	**Location**	**1-Tier 2-Row**	**2-Tier 1-Row**	**2-Tier 2-Row**	**3-Tier 1-Row**	**3-Tier 2-Row**
0 & 1	Ground & First Floor	None	None	None	None	None
	Above First Floor	None	EQ Bracing & Note 1	None	EQ Bracing & Note 1, 3	EQ Bracing
2	Ground & First Floor	None	EQ Bracing & Note 1	EQ Bracing & Note 2	EQ Bracing & Note 1, 3	EQ Bracing & Note 2
	Above First Floor	EQ Bracing & Note 2	EQ Bracing &Note 1	EQ Bracing	Do Not Use & Note 1, 3	EQ Bracing & Note 1
3	All Floors	EQ Bracing & Note 2	EQ Bracing & Note 1	EQ Bracing	Do Not Use	EQ Bracing & Note 1, 3

Chart Notes:

- "None" indicates that no further support other than that specified in 5.37.11 and 5.37.11 (3) is required.

- "EQ Bracing" indicates that additional hold-down assemblies for earthquake bracing are required for the batteries and/or stand as specified in standard drawings.

- "Do Not Use" indicates that the use of this type of stand is not permitted.

NOTE: 1: Battery stand joints must be epoxied if cells with a height over 18 inches are installed on the stand.

NOTE: 2: Steel base retainers are also required, installed in accordance with standard drawings.

NOTE: 3: Batteries over 20 inches in height shall **not** be used on these stand arrangements.

5.38. DESIGNATIONS

5.38.1. LEGIBLE, PERMANENT DESIGNATIONS

All designations shall be legible, placed at the prescribed location, and conform to the existing office designation pattern.

5.38.2. USE OF PROPER INK/STENCILING PRODUCT

Designations may be stenciled (stamped) or legibly/neatly handwritten with indelible ink, engraved or labeled. The only designation labels that are acceptable are labels designed and provided by the equipment manufacturer for use on telecommunication equipment and lettering systems employing thermal transfer technology (such as Merlin Express™) or system laser plate material (such as Brady Labels™).

A. The use of thermal transfer technology tape systems is limited to applications on smooth, nonporous surfaces. This system's tape shall **not** be used on ripple-finished surfaces or any other irregular surfaces.

B. Labels shall be placed in such a manner that they do not peel or lift but remain permanently affixed.

5.38.3. PROCEDURE FOR DESIGNATIONS ASSOCIATED WITH REMOVED EQUIPMENT

All designations on equipment remaining in an office associated with removed equipment shall be removed. This includes, but is not limited to, distributing frames, end guards, fuse and power board assignments, and DSX panels.

5.38.4. EQUIPMENT BAY/SHELF LABELING

All toll equipment bays or shelves shall have a label visible from the front of the bay showing the far end destinations for all conductors leaving the bay or shelf. Fiber tags must be labeled and affixed to the proper conductor to show battery A, battery B, battery return and primary and secondary timing conductors.

5.39. COLOR OF CHARACTERS

5.39.1. SELECTION OF INK(S) FOR CONTRASTING APPEARANCE

Black indelible ink shall be used on light surfaces and white indelible ink shall be used on dark surfaces. Bright red shall be used on caution surfaces.

5.40. SIZE OF CHARACTERS

5.40.1. SIZING OF CHARACTERS FOR APPLICATION LOCATION

Suppliers shall use the largest size lettering that will fit into the designated area. Refer to Section 6, Table 4, for recommended sizes of characters.

5.41. STAMPING AND DOCUMENTATION

5.41.1. EQUIPMENT ITEMS REQUIRING DESIGNATIONS

Supplier must stamp or label all:

A. Frames, bays, cabinets or positions with name and number (front and rear).

B. Equipment code (HECI) designation on shelves or units.

C. Units, subassemblies and other frame-mounted electronic apparatus with name and circuit (or unit/shelf) number (as applicable) (front and rear).

D. Battery stands shall be labeled as to clearly identify battery string and cell.

E. Distributing frame horizontal - numbers and shelf letters as follows:

- All vertical numbers will be stamped on the fourth (D) and tenth (K) shelf from the floor. All shelf letters will be stamped on the first vertical and every fifth vertical thereafter (vertical 1, 6, 11, 16, etc.). At locations where the vertical number and shelf letter are both located, the shelf letter shall precede the vertical number (such as D1, K6,

etc.). If the location of the stamping cannot be determined by the existing office pattern, the stamping will be placed on top of the terminal strip near the transverse arm, or if no terminal strip is installed, on the stiffening bar between the transverse arms. If no stiffening bar is provided, stamp the transverse arm. When a terminal strip stamped with a vertical number or shelf letter is removed, the stiffening bar or transverse arm must be stamped. Conversely, when a block is added and covers the designation on the arm the added block shall be stenciled. Refer to Section 6, Figure 89.

F. Distributing frame vertical - number and shelf letters as follows:

- All vertical numbers will be stamped on the seventh terminal strip (G) location from the floor. All shelf letters will be stamped on the first vertical and every fifth vertical thereafter (vertical 1, 6, 11, 16, etc.). At locations where the vertical number and shelf letter are both located, the vertical number shall precede the shelf letter (such as 1G, 6G, etc.). If the location of the stamping cannot be determined by the existing office pattern, the stamping will be placed on the front of the terminal strip near the transverse arm, or if no terminal strip is installed, on the transverse arm. When a terminal strip stamped with a vertical number or shelf letter is removed, the transverse arm must be stamped. Conversely, when a block is added and covers the designation on the arm the added block shall be stenciled. Refer to Section 6, Figure 90.

G. Vertical numbers and pairgain numbers on cable board above protector locations.

H. Aisle signs or end guards to indicate existing and added equipment. If more than one CO switch is in the same room, all end guards of both switching entities will be marked with the CO switch designation (i.e., DS0, DS1, 10T, etc.).

I. Aisle switches with directional arrow. (This requirement applies only when rear aisle lighting is provided.)

J. AC outlets with voltages greater than 120V.

K. Fuse panel row designations (letters and numbers) (front and rear).

L. Fuse capacity on fuse panels or circuit breaker panels, or install fuse capacity pin or disc.

M. Voltage designations on fuse panels greater than 48 volts (i.e., -130v, etc.).

N. Fuse record book covers with bay location.

O. Common Language Equipment Identification (CLEI) code and circuit or terminal identification designation on all units that are included in the circuit assignment and provisioning activities of the AOC. These codes shall be conspicuously located and visible when viewed from the in-service or installed position.

P. Power service cabinets with name, number, voltage and labeled ISOLATED AC if serving isolated ground plane equipment.

Q. Designations associating alarm fuses with discharge fuses.

R. Frame numbers associated with the cartridge fuse or circuit breaker on power boards and distribution bays (front only). If the frame number designation could be duplicated, the floor number of the frame shall also be stamped on the front of the power board. The fuse/circuit breaker position number shall be stamped on front and rear.

S. ITEM LEFT BLANK INTENTIONALLY

T. ITEM LEFT BLANK INTENTIONALLY

U. Bus bars outside of the power plant area with potential and group designation (such as "-48V Load A," "Battery Return," etc.) in 3/4-inch lettering.

V. Bus bars associated with the CO Ground System or Isolated Ground System with the functional designation of the bar in 3/4-inch lettering. This includes the CO Ground Bar, Main Ground Bar (MGB), Office Principal Ground Point Bus (OPGPB), etc., and collection bars or splice plates such as Integrated Collection Bar (ICB), Integrated Ground Splice Plate (INGSP), Frame Bonding Equalizer (FBE), etc. A sign at the bus bar may be used instead of stamping at the discretion of the AOC representative.

W. BDFBs with size and location of primary fuse. Label in front of bay (under meter, if applicable).

- **Fiber optic cable racks,** ducts or troughs shall be stamped or labeled as per Section 5.8.6 of this document.

- **Power cable racks** or troughs shall be stamped or labeled as per Section 5.8.7 of this document.

- **Fiber Optic Hazard Warning** labels shall be installed per Section 5.15.7 of this document.

- **Cable racking carrying unfused battery leads,** between batteries and rectifiers, shall be stamped or labeled per Section 5.33.9 of this document.

- **High voltage receptacles** shall be stamped or labeled as per Section 5.35.2 of this document.

5.41.2. PROPER DESIGNATION OF FUSES

All AC and DC fuses shall be designated with circuit number, circuit name, and frame location if different from frame in which fuse panel is located. The designations may be provided in fuse record books, stamped or labeled on fuse panels.

A. When fuse record books are used, all new or added circuits shall be listed on the fuse record sheets with blue or black ink. After ten non-typed entries, the fuse record sheet shall be retyped or reprinted

B. Standard fuse assignments may be provided on shop-prepared and installed labels. In cases where the fuse is not installed, the installer shall modify the shop-prepared label by removing the designation or marking the designation "future."

5.41.3. DESIGNATIONS WITH REMOVED EQUIPMENT

All entries shall be removed from fuse record sheets for circuits removed from fuse panels.

5.41.4. DESIGNATIONS REQUIRED FOR TROLLEY COUPLINGS/END CAPS

Trolley couplings or end caps shall be stamped or labeled "Disconnect AC before opening."

5.41.5. DESIGNATING AC OUTLETS WITH SOURCE INFORMATION

All AC Outlets and switches shall be stamped or labeled with the location of power source and circuit breaker number or inverter frame location. This includes outlets and switches located on end guards of switching equipment. AC power strips with multiple outlets (such as those used with data mountings) need to be designated once near the first outlet on the strip.

5.41.6. OFFICE DRAWINGS/ACORN RECORDS

All initial installations, removals or assignment changes shall be marked on office base drawings (if applicable) and by electronic application (i.e., ACORN, power database, etc.).

5.41.7. OFFICE CLOCK LEAD INFORMATION

All timing source generator leads shall have at the equipment (load) end, a tag or label showing primary or secondary timing, relay rack, shelf and terminal of the timing supply. At the timing supply the card, book or drawing shall be designated to show the appropriate assignment.

5.41.8. ITEM LEFT BLANK INTENTIONALLY

5.41.9. LABELING FOR DISTRIBUTING FRAME COVERS

The installer shall stamp or label distributing frame terminal strips and/or covers as instructed in the TEO or drawings. When new equipment is added, the inside covers shall be updated.

The minimum requirements are:

A. Functional lead designation for each circuit type (at least one row per terminal strip).

B. Circuit designation (by name or drawing number).

C. Equipment location (relay rack number, etc.).

5.41.10. BONDING/GROUNDING "FAR END DESTINATION" TAGS

A fiber tag shall be placed at each end of all bonding and grounding conductors and any operational conductors (i.e., logic grounds, etc.) showing far end destination. The designations may be stamped, labeled, engraved or legibly/neatly handwritten. The tags are not necessary on short conductor lengths where the destination of both ends are apparent. Tie wraps shall **not** be used to secure the tag to the cable.

5.41.11. GROUNDING CONDUCTOR DESIGNATIONS AT MGB (GROUND WINDOW)

A fiber tag shall be placed on all conductors terminated on the MGB of the ground window showing far end destination. The designations may be stamped, labeled, engraved or legibly/neatly handwritten. This includes all bonding, grounding and battery return conductors. Tie wraps shall **not** be used to secure the tag to the cable.

5.41.12. BATTERY/BATTERY RETURN "FAR END DESTINATION" TAGS

A fiber or plastic tag shall be placed at each end of all battery and battery return distribution cables. Battery and battery return conductors on units or shelves fused from a source outside of the frame must be designated with the source location. At the load end, the tag shall provide location of source (frame and fuse position). At the source end, the tag shall provide the

location of the load (frame name and number). The designations may be stamped, labeled, engraved or legibly/neatly handwritten. Tie wraps shall **not** be used to secure fiber tags to the cable. The tags are required on both ends of all BDFB/BDCBB frames, power plants, toll/transmission loads and other common equipment area equipment. In the switching area, the following requirements shall be followed:

- At the load end (equipment frame), no designation tag is required for battery or battery return leads.
- At the distribution bay (PD, PCFD, PDC), no designation tag is required for the battery leads (secondary power distribution); however, a tag is required for the battery return leads.
- At the distribution bay (PD, PCFD, PDC), the battery and battery return cables to the power plant (primary power distribution) will require tags designating the source end of these conductors.

5.41.13. LABELING DSX1/DSX3 CROSS CONNECT PANELS

Digital system cross connect (DSX) panels shall be stamped or labeled with basic cross-connection information as leads are terminated on the panel (not required on rear). At a minimum, the following information must be provided on all designation strips of the DSX panel:

A. Frame/module name and number or relay rack number.

B. Circuit number (such as channel, bank, repeater, multiplexer, fiber terminal, etc.).

C. Every jack will be numbered with its associated number within the circuit.

5.41.14. LABELING LGX FIBER SHELVES

In addition to the other designation requirements of this section, fiber distribution frame shelves shall be stamped or labeled as follows:

A. On the front of the shelf, fiber couplers will be labeled starting with coupler 1 at the top left of the shelf, and coupler 6 at the bottom left, and continuing to coupler 67 at the top right and coupler 72 at the bottom right of the shelf. (If local practice dictates, the pattern of A1, A6 to M1, M6 can be substituted for the above.)

B. On the rear of the shelf, fiber couplers 1, 6, 31, 36, 37, 42, 67 and 72 shall be labeled. (If local practice dictates, the pattern of A1, A6 to M1, M6 can be substituted for the above.)

C. The Network Designation labels on the front of the shelf will be filled in for all fibers installed, identifying the frame identification and unit number.

5.41.15. VERIFICATION/PROPER LOCATION OF BAR CODE LABELS

The installer shall verify that all plug-in units provided with the equipment being installed are equipped with bar code labels that provide for the automatic identification of the unit by AOC computer inventory systems. The labels shall **not** be damaged and shall be located so that the bar code can be electronically scanned when the plug-in is in its in-service position. No markings shall be placed over the bar codes.

5.41.16. DSX-3 LABELING

DSX-3 labeling areas will be designated as area(s) A, B, C and D from top to bottom of the module as indicated in AM-002-510-014, Attachment 1. Labeling is to be performed as follows (also see NOTE):

Area A - Designate the equipment type and bay location across the entire panel.

EXAMPLE

```
FMT-150 336.02

LTS-21130 440.06
```

Area B - (This area for local assignment by central office technician). Designate the circuit identification number. In those circumstances where the complete circuit identification number will not fit due to space limitations, creativity will prevail. Some suggestions are CAC code or partial circuit number. Due to the possibility of work error, this area is not allowed to be left blank under any circumstances. If there is a working circuit, an identification MUST be made.

Area C - Designate the DS-3 number or multiplexer number.

Area D - Designate the equipment shelf number associated with the bay location in Area A.

NOTE: In those situations where only two areas are allocated for labeling, (one at the top and one at the bottom), the top is to be used for equipment type and bay location (as in Area A) and the bottom is to designate the circuit identification number (as in Area B).

5.41.17. FIBER OPTIC CONDUCTOR IDENTIFICATION

All fiber optic conductors should be identified by label or tag at each end in all switching equipment bays.

5.42. CIRCUIT NUMBERING

5.42.1. RECOMMENDED GROWTH PATTERN

The direction of growth and numbering of individual circuits on equipment frames should be from left to right (facing the front of the equipment) and, unless otherwise specified by the AOC representative, from bottom to top.

5.42.2. RECOMMENDED DISTRIBUTING FRAME NUMBERING PATTERN

On the vertical side of distributing frames, circuit numbering should be from top down. On the horizontal side, circuit numbers shall be numbered from left to right (facing the front of the terminal strip).

5.43. TEMPORARY INSTALLATIONS

5.43.1. TEMPORARY CABLE INSTALLATION REQUIREMENTS

All temporary cabling and wiring should be run on temporary racking as a first choice and cable straps if racking is not practical. Cabling shall **not** be suspended by lacing cord or cable ties at any locations and will be protected as necessary per Sections 5.12 and 5.18.1 (1).

5.43.2. SWITCH EQUIPMENT INSTALLATIONS INVOLVING "HOT SLIDES"

Switch cabinets associated with hot slides shall be bolted to the floor in the temporary location regardless of the earthquake zone area of installation.

5.43.3. POWER PLANT INSTALLATIONS IN TEMPORARY LOCATIONS

All bus bars (ground, battery return, etc.) shall be bolted in the temporary location regardless of the earthquake zone area of installation.

5.43.4. INSTALLATION OF TEMPORARY FIBER OPTIC CABLING

All temporary fiber optic cables shall be run using temporary raceways (spiral wrap, split harness protective sheathing, etc., will be acceptable for this application). Cables shall **not** be run over auxiliary bars, ladder tracks, light fixtures, threaded rods, etc.

5.43.5. SAFETY/SERVICE IN TEMPORARY INSTALLATIONS

In all cases, all temporary installations shall adhere to standard safety and service practices.

5.43.6. TEMPORARY INSTALLATION TIME INTERVAL LIMIT

A temporary installation is usually considered one year or less.

6. TABLES AND FIGURES

6.1. GENERAL

6.1.1. INFORMATION CONTAINED IN THIS SECTION

This section contains the Tables, Figures, and Reproducible Forms referenced in other sections of this document.

6.1.2. TABLES AND FIGURES

The following tables and figures are part of this section:

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Anchor Bolt Pattern for Securing Frames in a Lineup	Figure 85
Battery Charge Report Form	Figure 29
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6.2. FORMS

6.2.1. SAMPLE FORMS

The forms included herein are examples used to show the information required by the AOCs. Supplier forms may be used if all the data shown on the attached examples are included on the Supplier forms.

6.2.2. REPRODUCIBLE FORMS

Reproducible copies of the forms are included at the end of this section for Suppliers who do not have forms that contain the required information.

Table 1	
MAXIMUM ALLOWABLE DEVIATION FROM VERTICAL PLUMB	
HEIGHT	MAXIMUM DEVIATION
4’6" and less	1/16"
Between 4’6" and 7’0"	1/8"
7’0" to 9’0"	3/16"
Over 9’0"	1/4"

Table 2			
SEWING HORIZONTAL RESTING RUNS			
Size of Wire	Sew at Strap	Number of Twine Strands	Wires per Stitch
750 MCM to 400 MCM	4th	4*	2
350 MCM to No. 1/0 AWG	4th	2	4
No. 1 AWG to No. 6 AWG	3rd	2	4
No. 8 AWG to No. 14 AWG	3rd	2	Any number up 1" diameter bundle

- Where superimposed on cable runs sewn with two strands, two strands may be used.

NOTE: Cabling run on "L" shaped brackets will be supported at intervals not to exceed 18 inches for 1/0 to 750 MCM conductors and 9 inches for 14 AWG to 1 AWG conductors. All conductors will be secured in accordance with Table 2.

NOTE: When existing cable runs are sewn at different strap intervals than the requirements of Table 2 specify, one of the following procedures will be followed when additional cable is being run:

Procedure 1 applies to one layer of existing power cable (size 350 MCM to 750 MCM) not sewn per Table 2, two layers of existing power cable (size No. 1/0 AWG to No. 4/0 AWG) not sewn per Table 2 or three layers of existing power cable (size No. 14 AWG to No. 1 AWG) not sewn per Table 2:

- The installer shall sew the cables to the standard of Table 2 by reestablishing the sewing pattern specified in Table 2.

Procedure 2 applies to over one layer of existing power cable (size 350 MCM to 750 MCM) not sewn per Table 2, over two layers of existing power cable (size No. 1/0 AWG to No. 4/0 AWG) not sewn per Table 2 or over three layers of existing power cable (size No. 14 AWG to No. 1 AWG) not sewn per Table 2:

- The installer shall sew the cables to the existing pattern with the ultimate pile up cables not to exceed four layers of cables (size 350 MCM to 750 MCM) or five layers of cables (size No. 14 AWG to No. 4/0 AWG).

Table 3

SEWING VERTICAL OR INVERTED HORIZONTAL RUNS

Size of Wire	Sew at Strap	Number of Twine Strands	Wires per Stitch
750 MCM to 300 MCM	Every	4*	1
No. 4/0 AWG to No. 1 AWG	Every	4*	1

No. 2 AWG to No. 6 AWG	Every	2	2
No. 6 AWG to No. 14 AWG	Every	2	Any number up 1" diameter bundle

NOTE: * Where superimposed on cable runs sewn with two strands, two strands my be used.

Table 4

PREFERRED SIZES IN INCHES OF CHARACTERS FOR COMMON APPLICATIONS ON FRAME AND RACK MOUNTED EQUIPMENT

STAMPING LOCATION	SIZE
Aisle End Guards	3/4
RR Designations	3/4
Equipment Designations	
Shelf Numbering	3/8
CLEI Codes	3/8 or 1/4
BDFB, PB DM PDC, etc.	
Fuse Position	3/8
Fuse Assignments	3/8
Fiber Tags	1/4
DSX Panels	
Shelf Numbering	3/8
Slot Assignments	1/4
VMDF	
Term Board	3/4
Cable Heading	1/4
HMDF	
Terminal Covers - Outer	3/8
Terminal Covers - Inner	1/8

Table 5	
ALLOWABLE CABLE BEND RADIUS	
Size of Wire	**Minimum Bending Radius to Inside Edge**
No. 14 AWG	1/4 inch
No. 12 to 10 AWG	1/2 inch
No. 8 to 4 AWG	1 inch
No. 2 to 1/0 AWG	1 1/2 inches
No. 2/0 to 4/0 AWG	3 1/2 inches
250 to 500 MCM	5 inches
550 to 750 MCM	7 inches

This chart is to be used for standard power cables (included are special application power cables such as flex-type cables). If manufacturer specifies a minimum bending radius greater than the minimum listed in this table, the manufacturer's requirements shall be followed.

Figure 1.

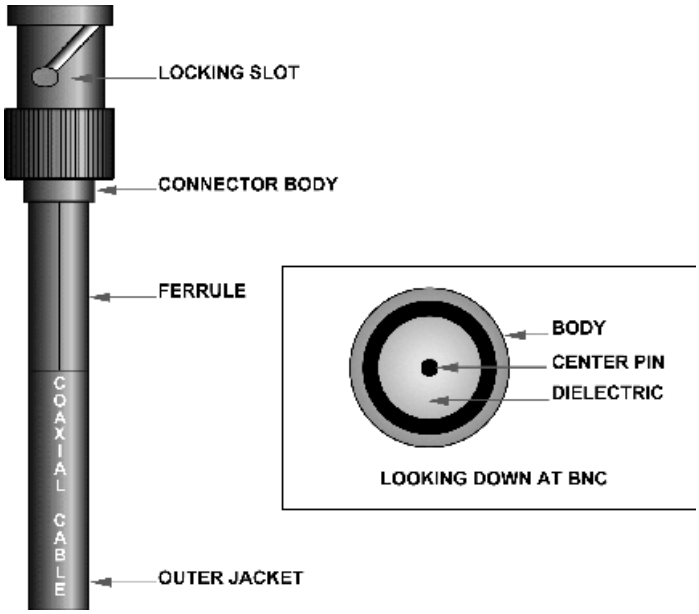
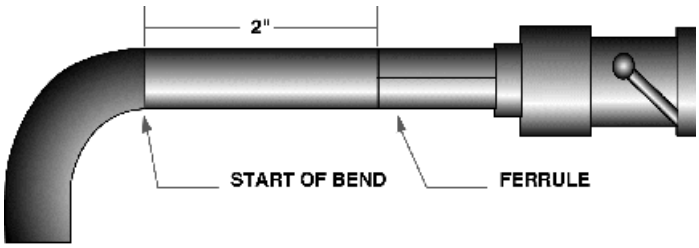
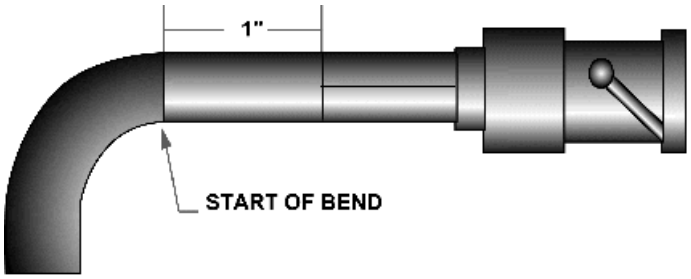


Figure 2.



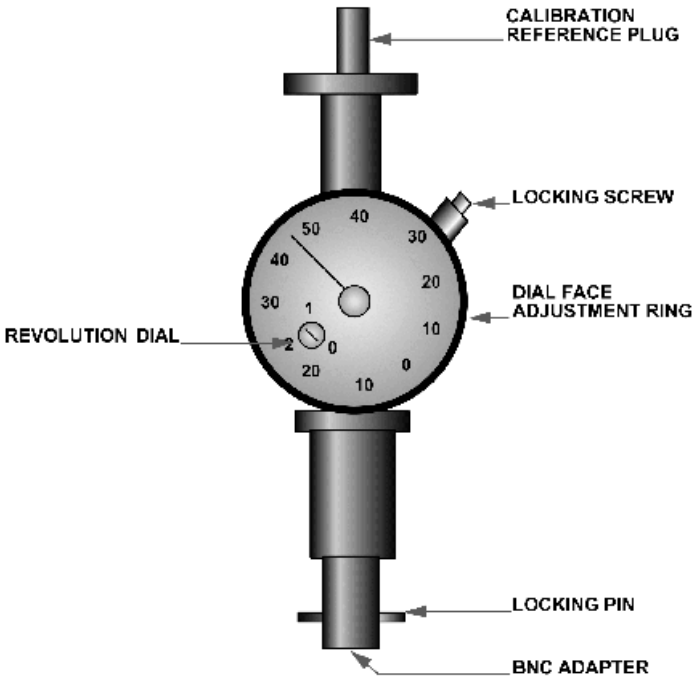
Acceptable bend with 2 inches from ferrule to the start of the bend

Figure 3.



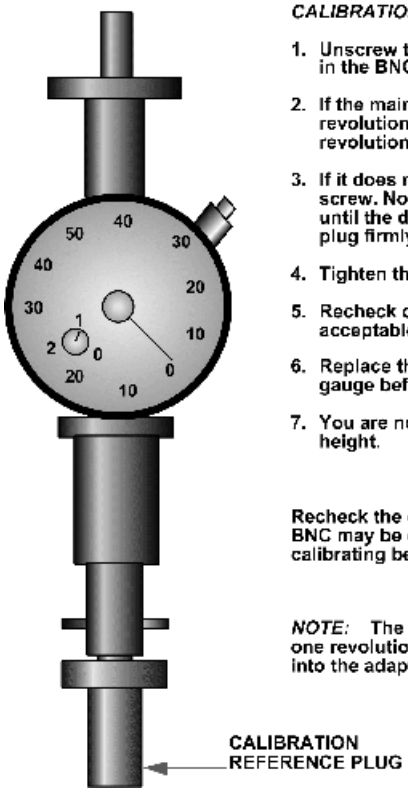
Unacceptable bend less than 2 inches from start of bend to the ferrule.

Figure 4.



Note: Disregard the dial face reading when there is no BNC or Calibration Plug in the BNC adapter. The dial face may indicate a reading other than zero.

Figure 5.



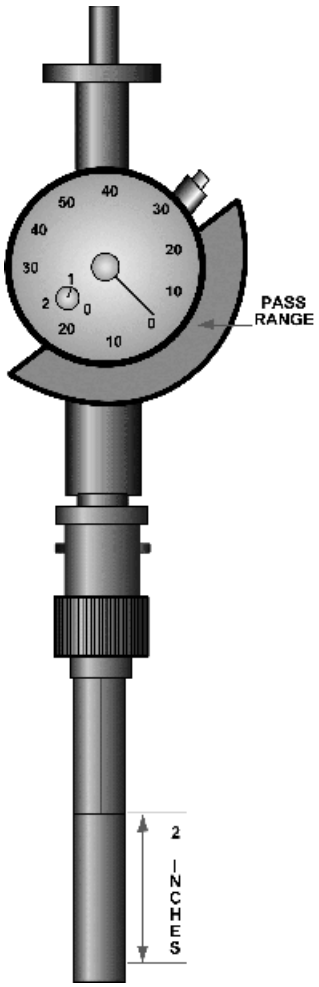
CALIBRATION

1. Unscrew the calibration plug and place it firmly in the BNC adapter.
2. If the main dial now reads zero and the revolution dial shows approximately one revolution, the gauge is adjusted.
3. If it does not read zero, loosen the locking screw. Now turn the dial face adjustment ring until the dial face reads zero, with the calibration plug firmly in place.
4. Tighten the locking screw.
5. Recheck calibration. If calibration is not acceptable, re-calibrate the gauge.
6. Replace the calibration plug back on top of the gauge before taking any readings.
7. You are now ready to start checking BNC pin height.

Recheck the calibration before each use. Multiple BNC may be checked at one time without re-calibrating between each BNC.

NOTE: The revolution dial shows approximately one revolution when the calibration plug is inserted into the adapter.

Figure 6.



MEASUREMENT

1. Place the BNC to be checked on the BNC Adapter and lock the connector in place.
2. Keep the coaxial cable straight for at least two inches from the ferrule.
3. The revolution dial needle should have made one complete revolution and should read approximately "1."
4. The needle on the main portion of the gauge should now read between the plus (+) or minus 20 (-).
5. If the BNC does not measure within + or - 20 with the revolution dial reading approximately 1, the BNC fails and needs to be replaced. If the BNC measures good and meets all other requirements. it may be placed back on the equipment and locked firmly in place.
6. Recheck that the BNC is fully seated and locked in place.
7. The coaxial cable should not be bent within 2" of the ferrule.

NOTE: It is possible to read a good pin height if the BNC center pin is very short or very long. In this case the revolution gauge *would not read* approximately 1, and is a failed BNC.

Figure 7.

SOLDER ON PIN

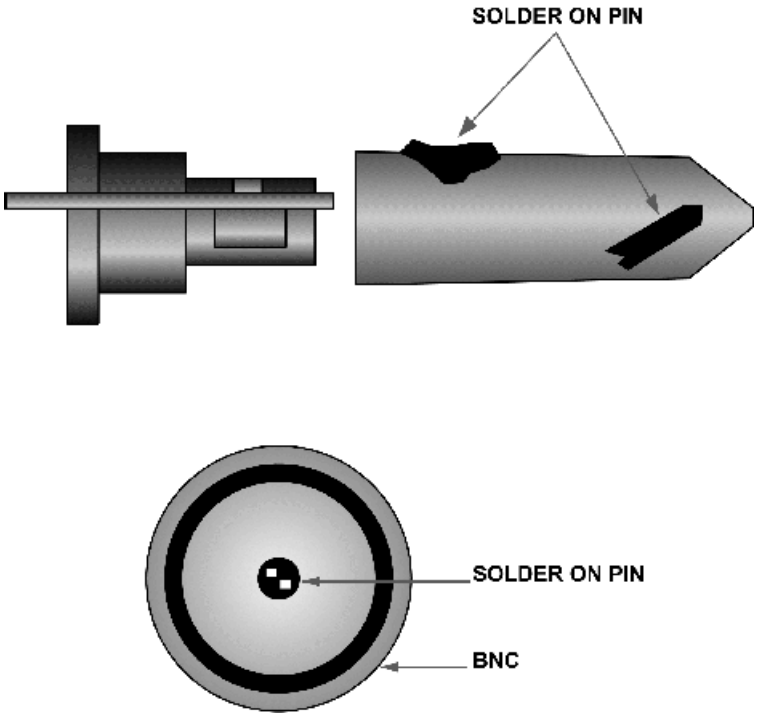


Figure 8.

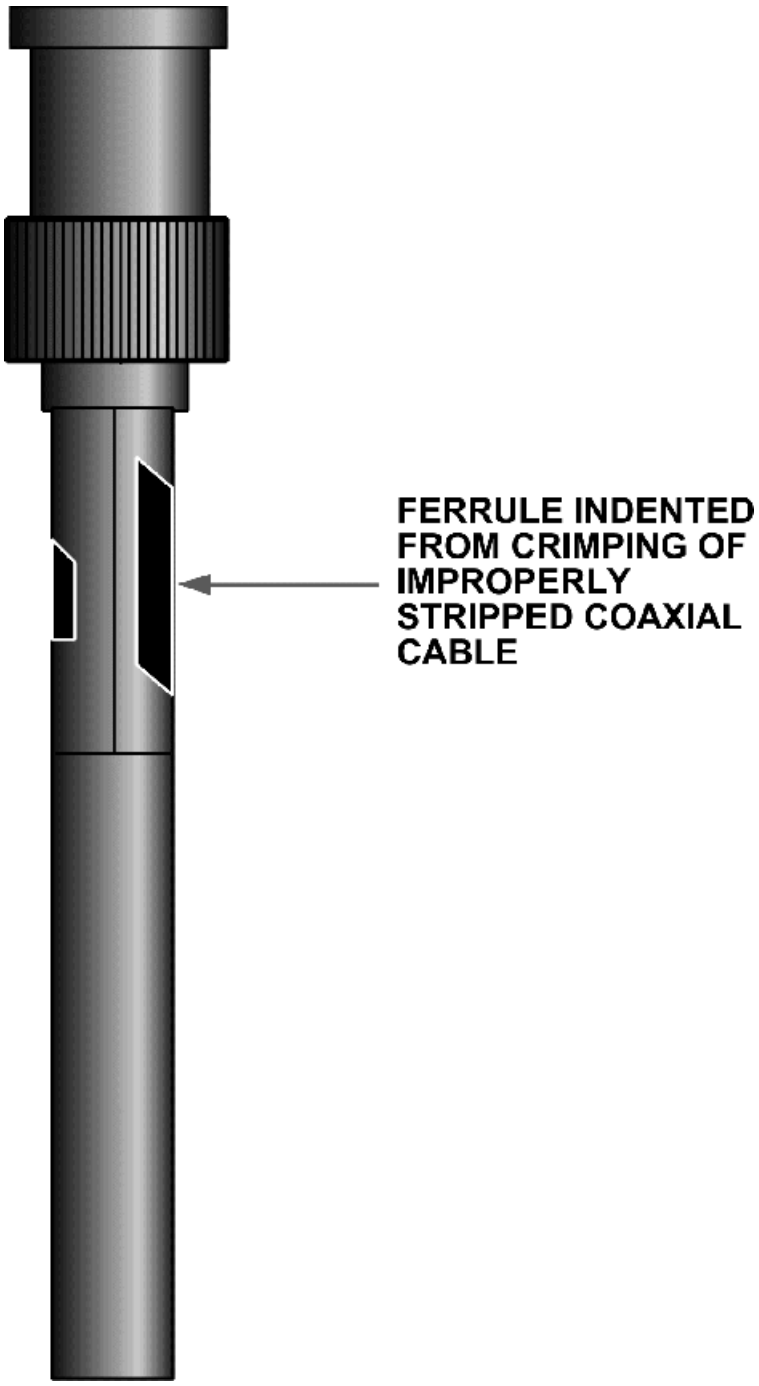


Figure 9.

Typical Roof Mounted Tower Grounding Schematic for Reinforced Concrete Building (IL-87107-059)

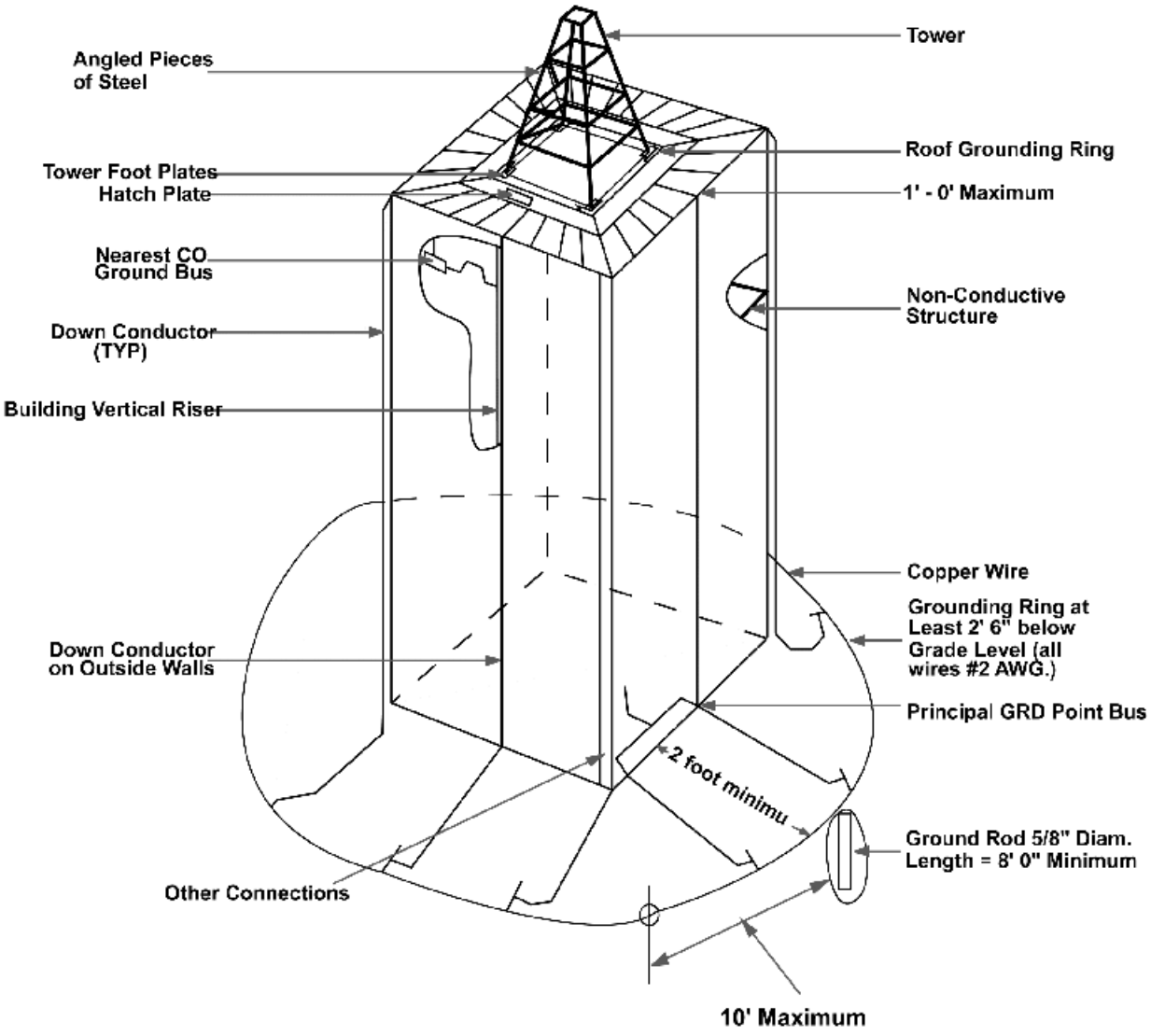


Figure 10.

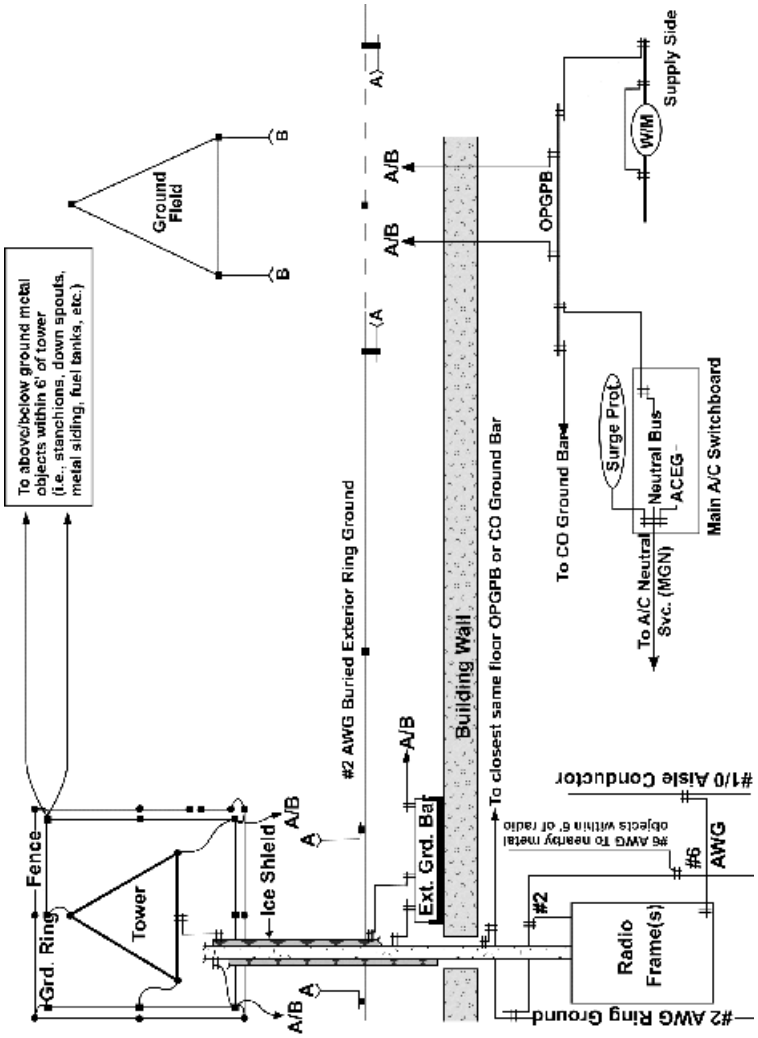


Figure 11.

COMMENTS

1. Fill in blanks in header.

2. List comments.

3. Mail to: M. Nolan
   Manager/Engineering
   N17 W24300 Riverwood Drive
   3rd Floor
   Waukesha, WI 53188

COMPANY _____
NAME _____
TITLE _____
ADDRESS _____
CITY & STATE _____ ZIP _____
TELEPHONE NUMBER _____

SECTION _____ PARAGRAPH _____
COMMENT _____

Sample Comments Form (Section 1.5.1)

Figure 12.

METHOD OF PROCEDURE

Sample MOP form - Sheet 1of 4 - (Section 3.4.2)

METHOD OF PROCEDURE AUTHORIZATION

Telco Order No._____
Supplier No._____
MOP No._____
Date _____
Page ____ of ____ Pages

TOWN _____ OFFICE _____

DATE/TIME
START _____ / _____ COMPLETE _____ / _____

TYPE OF SYSTEM _____

GENERAL DESCRIPTION OF WORK _____

This job has been reviewed and agreement reached on items listed on page two of this Method of Procedure. Responsibility for supervision of this job is assigned to:

Supplier _____
Title _____ Phone _____ Off-hour _____
Telco _____
Title _____ Phone _____ Off-hour _____

MOP prepared by _____

The undersigned approve this step-by-step procedure starting with page three. No changes shall be made without the written approval of the Telco Representative and concurrence by the Supplier Representative.

Supplier Representative _____
Title _____ Phone _____
Supplier Representative _____
Title _____ Phone _____

Approved by Telco Representative(s):

Telco Representative _____
Title _____ Phone _____
Telco Representative _____
Title _____ Phone _____

Figure 13.

METHOD OF PROCEDURE (Continued)

Sample MOP form - Sheet 2 of 4 - (Section 3.4.2)

CHECK LIST OF PERTINENT ITEMS

Telco Order No._____
Supplier No._____
MOP No._____
Page ____ of ____ Pages

Work should not start on this portion of the job until this form and the MOP have been signed by the Telco and Supplier representatives.

Place a check in brackets as each of the following items are discussed and agreed upon:

( ) 1. Equipment to be installed, modified, or removed.
( ) 2. Compatibility of the proposed equipment with existing equipment.
( ) 3. When working equipment might be affected.
( ) 4. When working equipment will be taken out of service.
( ) 5. Proximity of power plants and distributing systems and location of office power down procedures.
( ) 6. Where spare fuses are located.
( ) 7. Steps requiring the presence of a Telco supervisor.
( ) 8. Alarms to be disconnected and schedule of disconnects.
( ) 9. Records and drawings to be corrected.
( ) 10. Protection of equipment, floors, walls, etc.
( ) 11. Storage of tools and materials.
( ) 12. Safety precautions.
( ) 13. Service restoration procedure and responsibilities in the event of a service impairment.
( ) 14. Locations of essential and government circuits.
( ) 15. Normal work shift. Time to be stipulated:
Start of shift: _____ am/pm
End of shift: _____ am/pm
( ) 16. Disposition of removed equipment.
( ) 17. List of office and emergency contact numbers for Supplier and AOC representatives. (This may be posted in office as well as attached to MOP.)
( ) 18. Action to be taken in event of unusual conditions.
( ) 19. Additions or changes to an approved MOP.
( ) 20. Other pertinant factors.

List of documents (handbooks, practices, etc.) which outline general requirements, practices, precautions to be followed by Supplier during the installation period.

_____

_____

Figure 14.

STEP-BY-STEP PROCEDURE
Sample MOP form - Sheet 3 of 4
(Section 3.4.2)

Telco Order No.
Supplier No. _____
MOP No. _____
Page ____ of ____ Pages

In doing this job, the following steps must be followed in the order listed. Deviations from the procedure shall not be made without written approval of the Telco and Supplier representatives that signed page 1 of this document.

If, after completing pages 1 and 2, the Telco and Supplier representatives agree that a detailed step-by-step procedure is not required to prevent a service failure, a statement below, to that effect will complete this MOP.

The following important items must be locally included as steps in this procedure:

1. **Special safety precautions required.**
2. **Restricted hours (period) that work may be done.**
3. **Service release required, when and by whom released, when and by whom restored.**
4. **Insulated tools required.**
5. **Location of spare fuses.**
6. **Check operation of associated fuse alarms prior to start of the job.**
7. **Fuses and leads to be removed, tagged, and verified, and by whom.**
8. **General information, precautions, notes, check lists, reference to instructions and drawings that the step-by-step procedure follows.**
9. **Each item must be checked off as completed and initialed by the Telco representative before proceeding to the next turn.**

STEP#	DESCRIPTION	RESPONSIBILITY	
		TELCO	SUPPLIER

Figure 15.

METHOD OF PROCEDURE **(Continued)**

STEP-BY-STEP PROCEDURE

Telco Order No._____
Supplier No._____
MOP No. _____
Page ____ of ____ Pages

STEP#	DESCRIPTION	RESPONSIBILITY	
		TELCO	SUPPLIER

Figure 16.

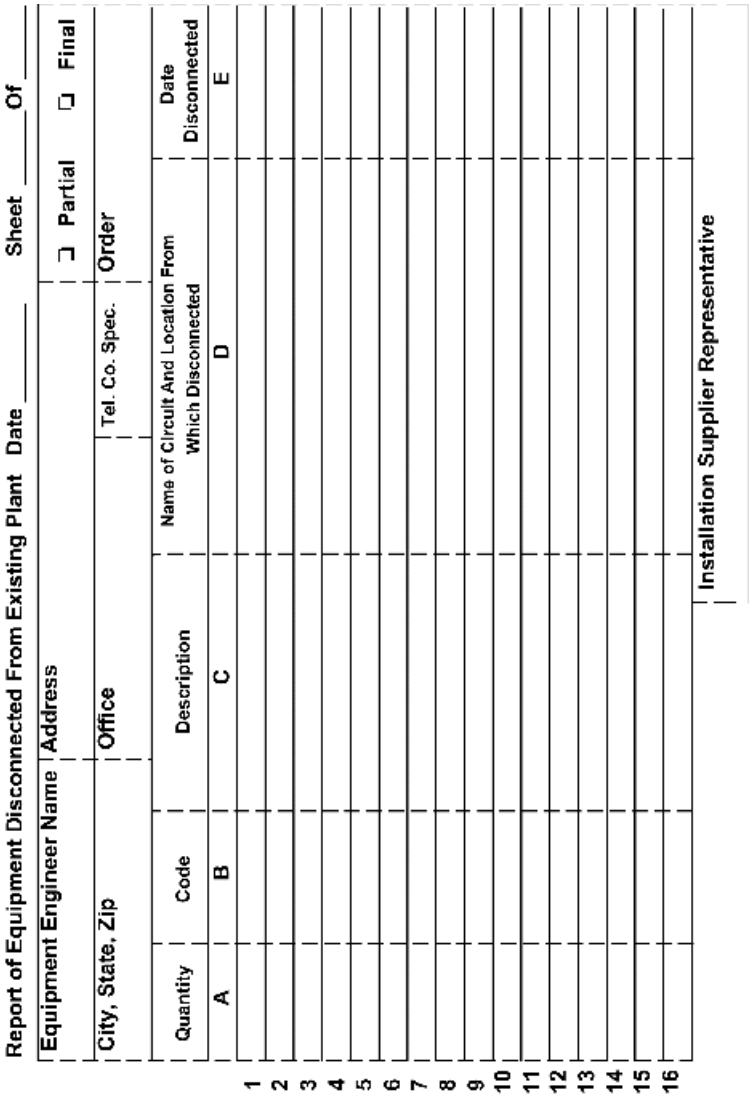


Figure 17.

COMPLETION REPORT AND CERTIFICATE OF ACCEPTANCE
Sample Completion Report & Certification of Acceptance (Section 4.4.1)

Telco Order No. _____ Supplier No. _____
Scheduled Completion _____ Date Issued _____

( ) Advanced Completion Date _____
( ) Job Completion Date _____
( ) Final Completion Date _____
( ) Revised Completion Date New Completion Date _____

1. City _____ State _____ Office _____
2. Description of job and change notices applied OR reason for revised completion date:
3. List minor job exceptions:
   Exception items agreed to by:
4. Documentation turned over to Telco. Yes ( ) No ( )
5. Equipment (was) (was not) removed on this job. The following forms have been issued for this removal (serial number and issue date):

   _____

   _____

6. Material disposition forms (were) (were not) issued on this order. List final serial number of each type form issued.

Supplier Representative(s):

_____

(Print) (Signed) (Date)

FOR TELCO USE ONLY

This order (is) (is not) acceptable. Reason for non-compliance:

_____

_____

_____

_____

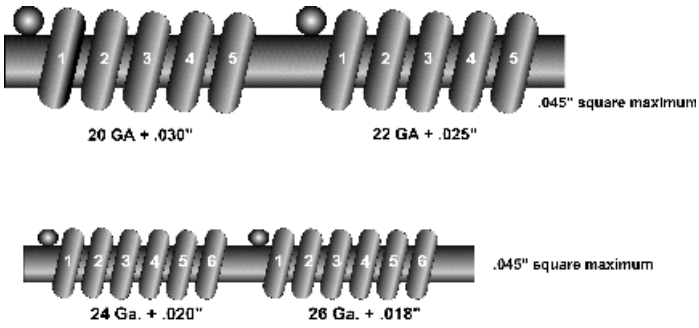
Telco Representative(s):

_____

_____

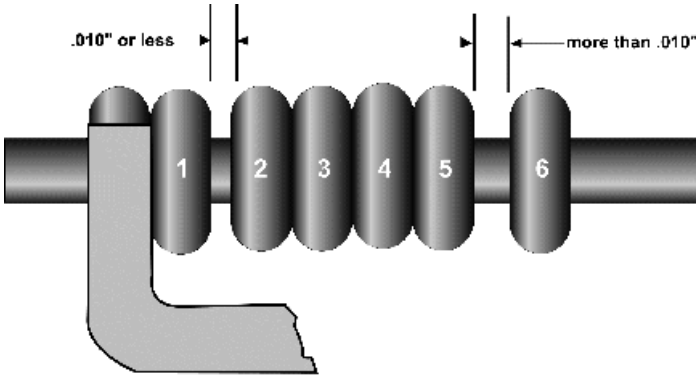
(Print) (Signed) (Date)

Figure 18.



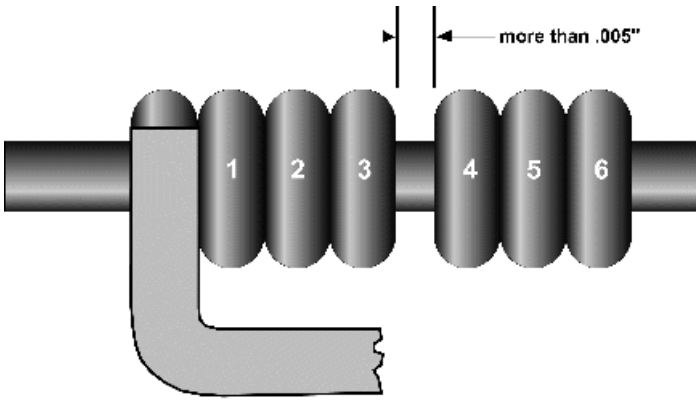
Wire Wrapped Connection - Standards (Section 5.27.1)

Figure 19.



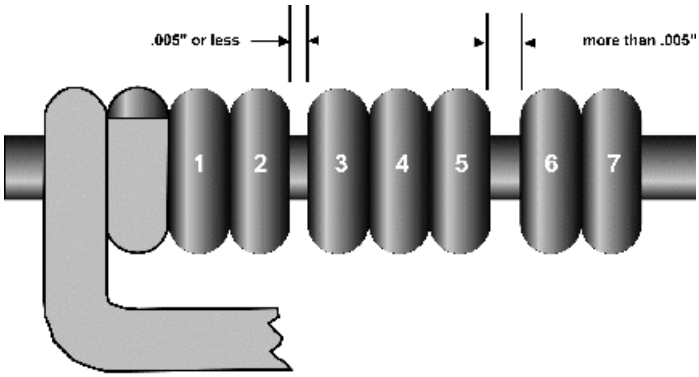
Wire Wrapped Connection - Excessive Space Between Turns (Section 5.27.1A and B)

Figure 20.



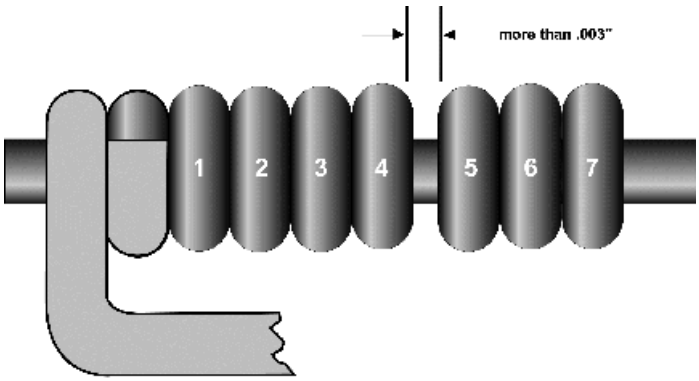
Wire Wrapped Connection - Excessive Space Between Turns
(Less than 4 adjacent turns for 20-, 22-, and 24-Gauge)
(Less than6 adjacent turns for 26-Gauge)
(Section 5.27.1A and B)

Figure 21.



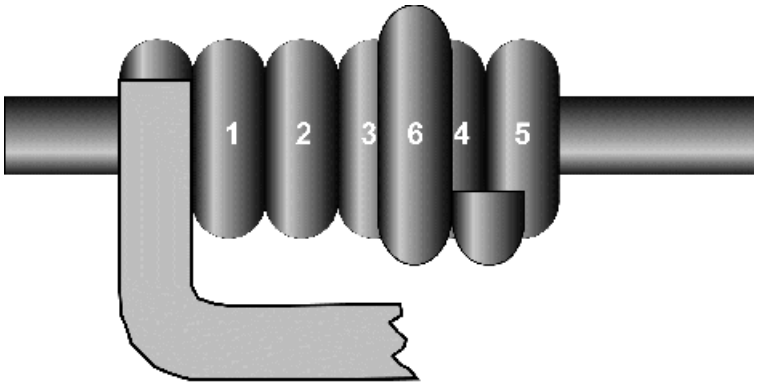
Wire Wrapped Connection - Excessive Space Between Turns
(Less than 5 adjacent turns for 28-, and 30- Gauge)
(Section 5.27.1C)

Figure 22.



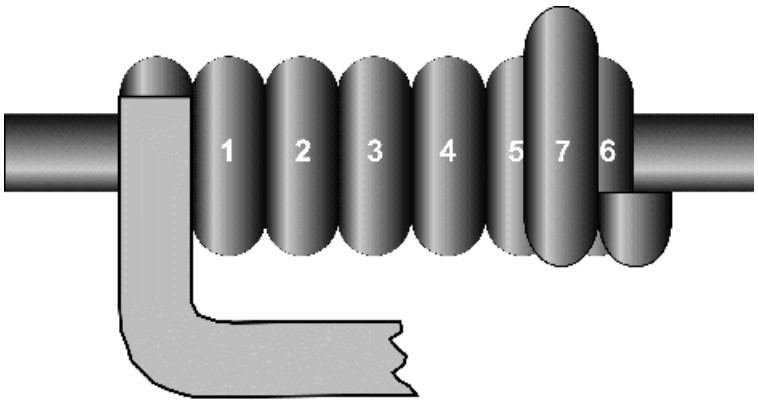
Wire Wrapped Connection - Excessive Space Between Turns
(Less than 5 adjacent turns for 28-, and 30-Gauge)
(Section 5.27.1C)

Figure 23.



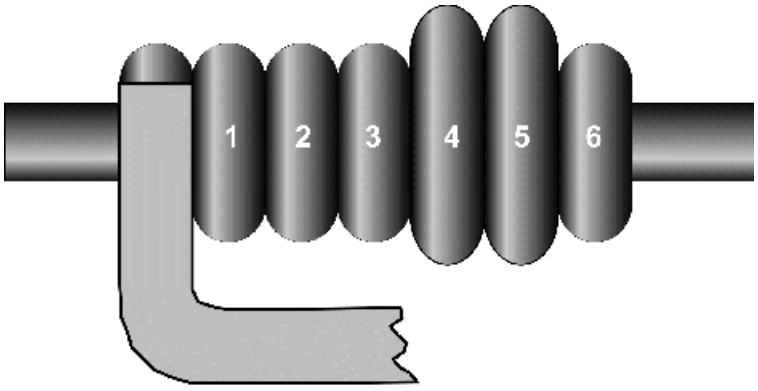
Wire Wrapped Connection - Overlapped Turns
(Section 5.27.1D)

Figure 24.



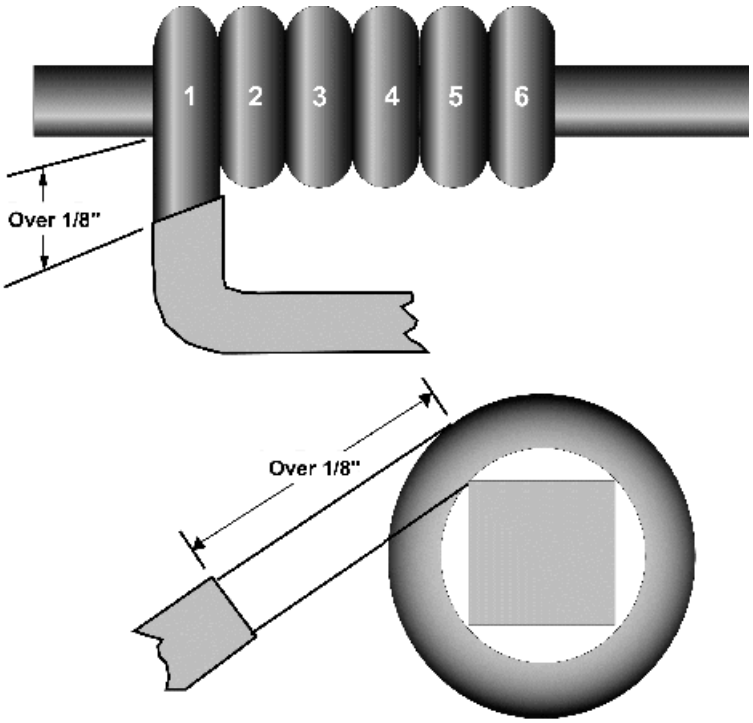
Wire Wrapped Connection - Overlapped Turn
(Section 5.27.1D)

Figure 25.



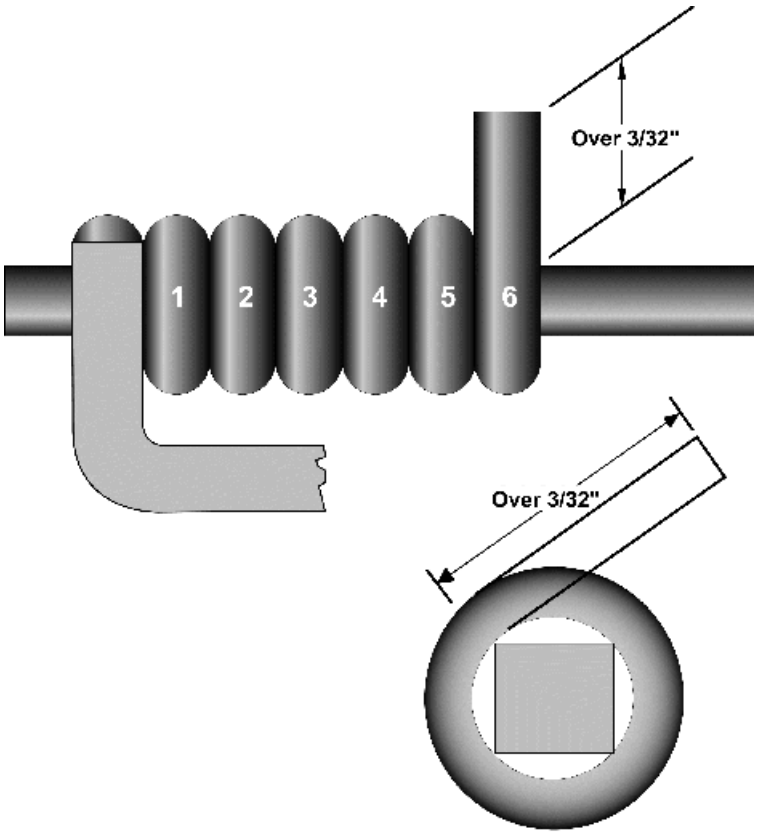
Wire Wrapped Connection - More Than One Bulged Turn
(Section 5.27.1E)

Figure 26.



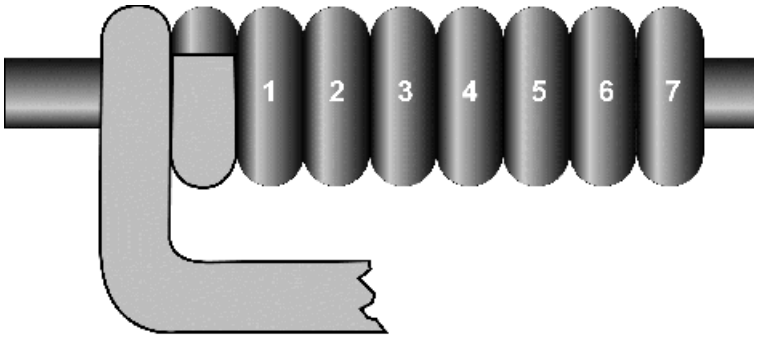
Wire Wrapped Connection - Connection with Excessive Shiner
(Section 5.27.1F)

Figure 27.



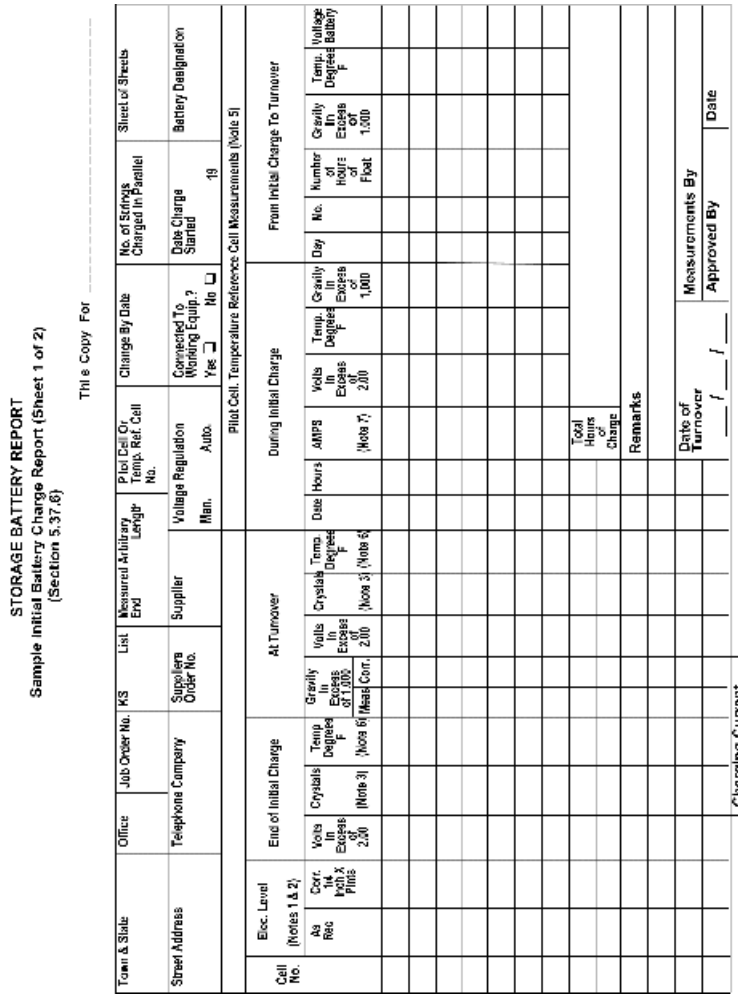
Wire Wrapped Connection - Connection with Excessive Pigtail
(Section 5.27.1G)

Figure 28.



Wire Wrapped Connection - Proper 28-, and 30-Gauge Connection
(Section 5.27.6)

Figure 29.



STORAGE BATTERY REPORT
Sample Initial Battery Charge Report (Sheet 1 of 2)
(Section 5.37.6)

This Copy For _____

Town & State		Office	Job Order No.	KS	List	Measured Arbitrary Length End		Pilot Cell Or Temp. Ref. Cell No.		Charge By Date		No. of Strings Charged In Parallel		Sheet of Sheets
Street Address		Telephone Company		Supplier's Order No.		Supplier		Voltage Regulation Man. Auto.		Connected To Working Equip.? Yes ☐ No ☐		Date Charge Started 19		Battery Designation

Cell No.	Elec. Level (Notes 1 & 2): As Rec	Elec. Level (Notes 1 & 2): Corr. 1/4 Inch X Plate	End of Initial Charge: Volts In Excess of 2.00	End of Initial Charge: Crystals (Note 3)	End of Initial Charge: Temp. Degrees F (Note 6)	End of Initial Charge: Gravity In Excess of 1.000 Meas.	End of Initial Charge: Gravity In Excess of 1.000 Corr.	At Turnover: Volts In Excess of 2.00	At Turnover: Crystals (Note 3)	At Turnover: Temp. Degrees F (Note 6)	During Initial Charge: Date	During Initial Charge: Hours	During Initial Charge: AMPS (Note 7)	During Initial Charge: Volts In Excess of 2.00	During Initial Charge: Temp. Degrees F	During Initial Charge: Gravity In Excess of 1.000	From Initial Charge To Turnover: Day	From Initial Charge To Turnover: No.	From Initial Charge To Turnover: Number of Hours of Float	From Initial Charge To Turnover: Gravity In Excess of 1.000	From Initial Charge To Turnover: Temp. Degrees F	From Initial Charge To Turnover: Voltage Battery
													Total Hours of Charge									

Charging Current

Pilot Cell. Temperature Reference Cell Measurements (Note 5)

Remarks

Date of Turnover ___ / ___ / ___

Measurements By

Approved By Date

Figure 30.

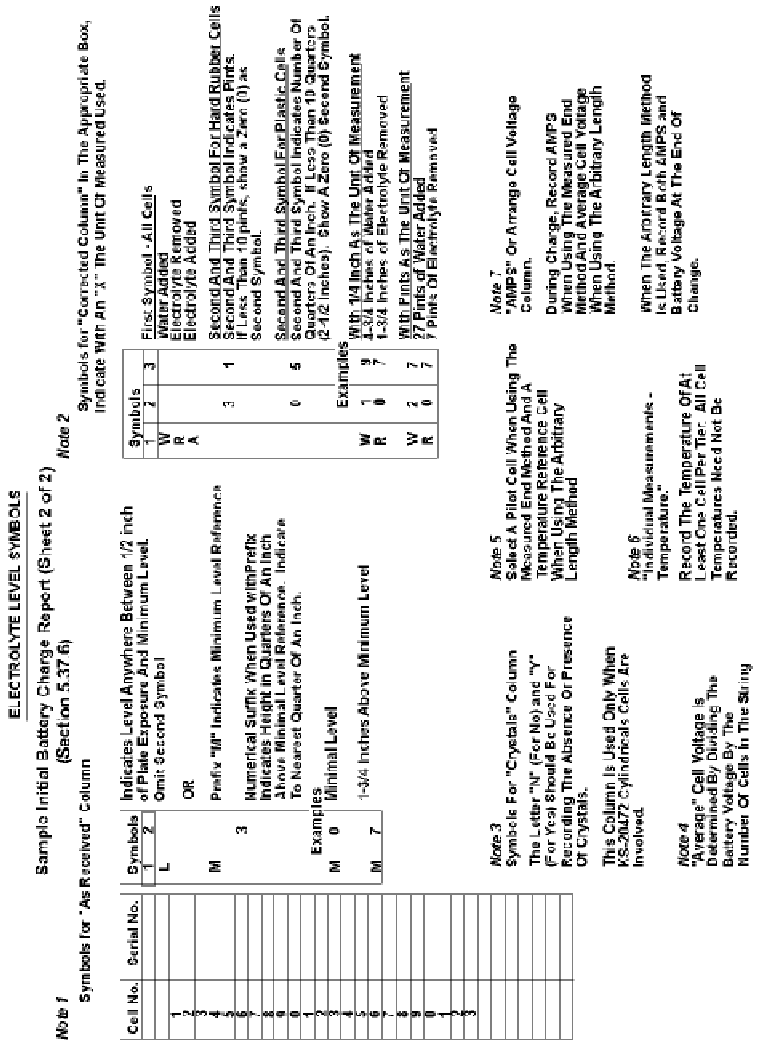
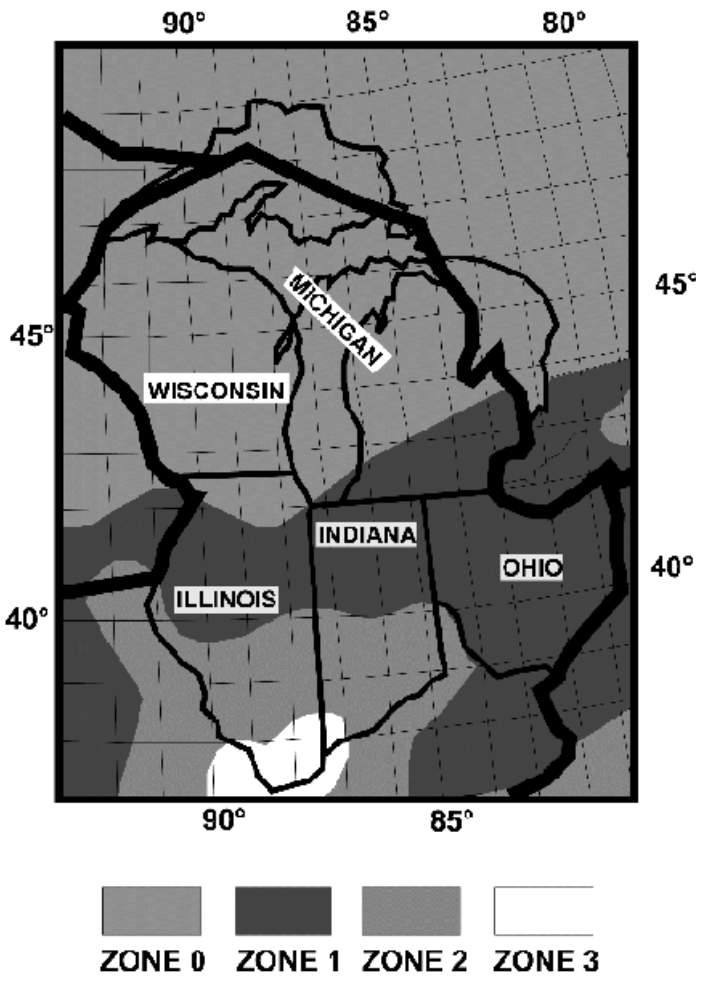


Figure 31.



Earthquake Zoning Map for the Ameritech Companies
(Sections 5.5.11, 5.11.10, 5.37.11)

Figure 32.

ZONE 2

COUNTIES	CURRENT ILLINOIS EXCHANGE LOCATIONS
Adams	Alton*
Bond	Aviston*
Calhoun	Beckemeyer*
Christian	Belleville*
Clark	Bethalto*
Clay	Bluford^
Clinton	Breese*
Coles	Brighton*
Crawford	Burton
Cumberland	Cahokia*
Douglas	Carlyle*
Edgar	Catlin*
Edwards	Centralia*
Effingham	Collinsville*
Fayette	Columbus
Franklin	Dix*
Green	East St. Louis*
Hancock	Edgemont*
Jasper	Edwardsville^
Jefferson	Elsah*
Jersey	Fairmount
Lawrence	Fowler
Macoupin	Freeburg*
Madison	Georgetown
Marion	Germantown*
Monroe	Glen Carbon*
Montgomery	Godfrey*
Moultrie	Granite City*
Perry	Greenville*
Pike	Harmony*
Richland	Indianola
Saint Clair	Luka^
Shelby	Kell*
Vermillion	Kinmundy*
(S. of Vermillion River)	Lebanon*
Wabash	Liberty
Washington	Marine*
Wayne	Mt. Vernon*
	Nashville*
	New Athens*
	O'Fallon*
	Payson
	Pontoon Beach*
	Quincy
	Ridge Farm
	Rosewood Heights*
	Salem*
	Trenton*
	Troy*
	Vandalia*
	Westville
	Wood River^

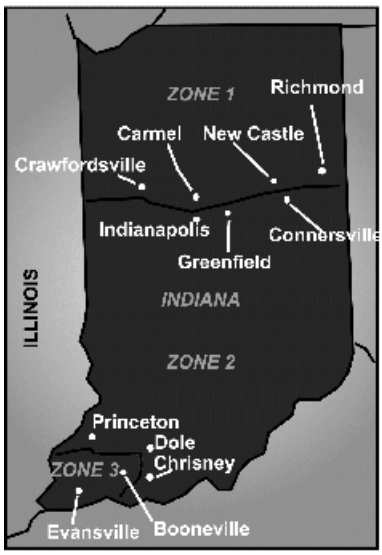
ZONE 3

COUNTIES	CURRENT ILLINOIS EXCHANGE LOCATIONS
Alexander	Cairo
Gallatin	Mound City
Hamilton	Mounds
Hardin	Olive Branch
Jackson	Olmsted
Johnson	Thebes
Massac	Tamms
Pope	
Pulaski	
Randolph	
Saline	
Union	
White	
Williamson	

* - Those offices in Zone 2 shall be engineered & installed in accordance with Zone 3 requirements. Contact AOC representative for additional details.

Earthquake Zone Map - Detail Zones 2 and 3
Boundary Map for Illinois

Figure 33.



ZONE 2

COUNTIES	CURRENT INDIANA EXCHANGE LOCATIONS
Bartholomew	Action
Brown	Bedford
Clark	Bloomfield
Clay	Bloomington
Crawford	Brownsburg
Daviess	Bruceville
Dearborn	Cayuga
Decatur	Charlestown
Dubois	Charlottesville
Fayette	Chrisney
Floyd	Clinton
Franklin	Columbus
Gibson	Dale
Greene	Dana
Hancock	Danville
Harrison	Dugger
Hendricks	Edinburgh
Jackson	Elizabethtown
Jefferson	Fairland
Jennings	Flat Rock
Johnson	Galena
Knox	Greenfield
Lawrence	Greenwood
Marion	Heltonville
Martin	Hope
Monroe	Indianapolis
Morgan	Jasonville
Ohio	Linton
Orange	Manilla
Owen	Marshall
Parke	Martinsville
Perry	Montezuma
Pike	Mooresville
Putnam	Morgantown
Rupley	Nashville
Rush	New Albany
Scott	New Palestine
Shelby	New Washington
Spencer	Oklandon
Sullivan	Paragon
Switzerland	Plainfield
Union	Rockport
Vermillion	Rockville
Vigo	Rosedale
Washington	Sandridge
	Sellersburg
	Shelbyville
	Spencer
	Tell City
	Vincennes
	Washington
	West Newton

ZONE 3

COUNTIES	CURRENT INDIANA EXCHANGE LOCATIONS
Posey	Boonville
Vanderburgh	Chandler
Warrick	Evansville
	McCutchanville Solitude
	Mount Vernon Tennyson
	New Harmony
	Newburgh
	St. Joseph
	St. Phillip

Earthquake Zone Map - Detail Zone 2 and 3
Boundary Map for Indiana

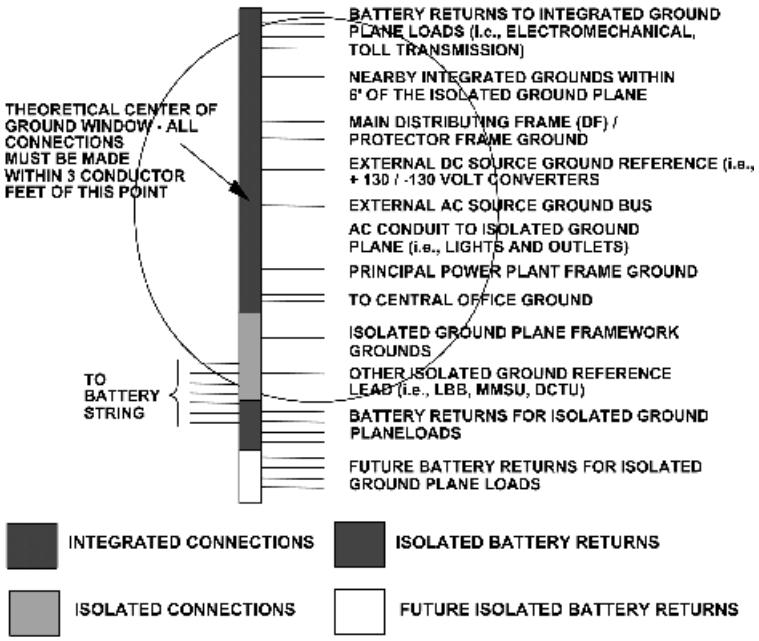
Figure 34.

ZONE 3

COUNTIES	*CURRENT OHIO EXCHANGE LOCATIONS*
Butler	Middletown
Clermont	Monroe
Hamilton	Trenton
Preble	

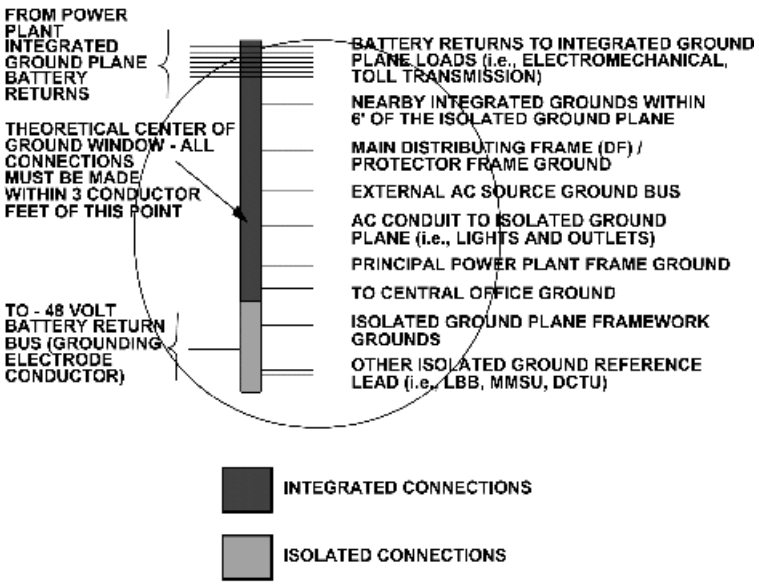
Earthquake Zone Map - Detail Zones 2 and 3
Boundary Map for Ohio

Figure 35.



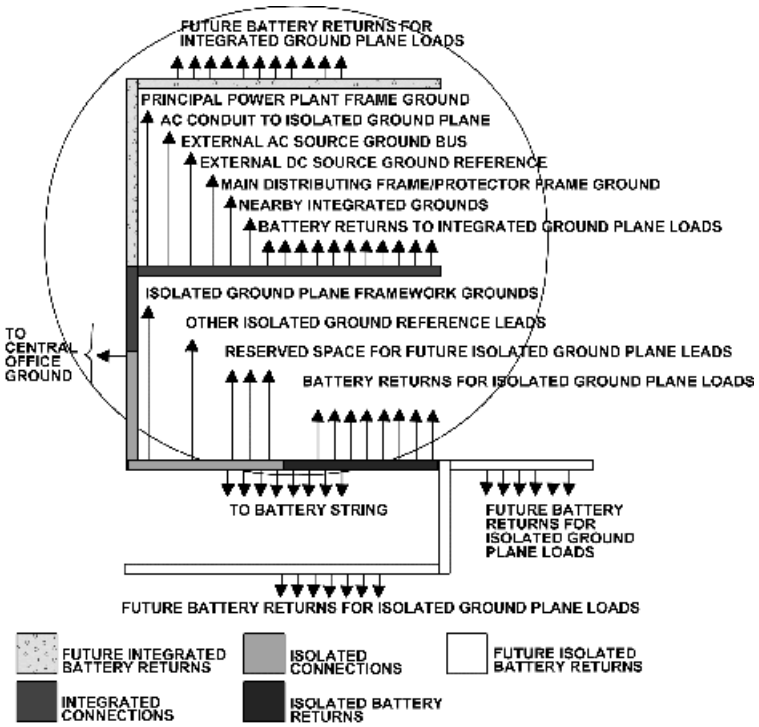
Recommended Ground Window Configuration When the Power Plant and the Ground Window are Collocated (Section 5.20.4D)

Figure 36.



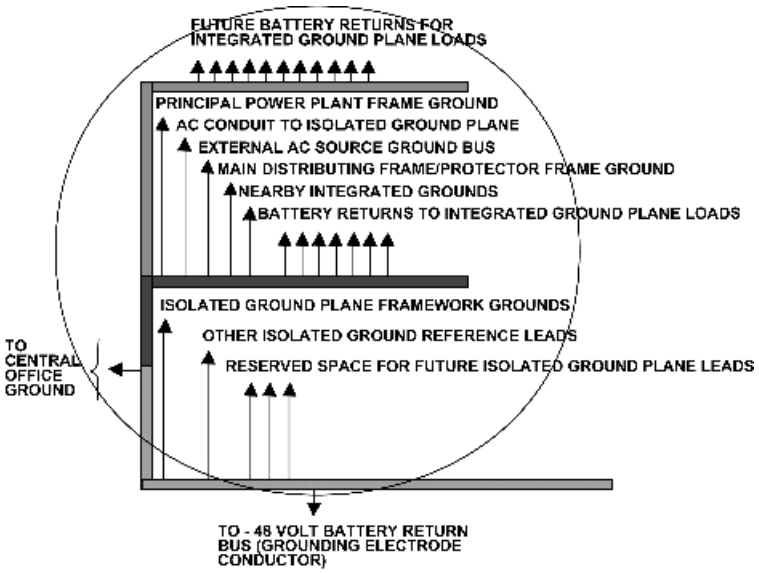
Recommended Ground Window Configuration when Power Plant and Ground Window are NOT Collocated
(Section 5.20.4D)

Figure 37.



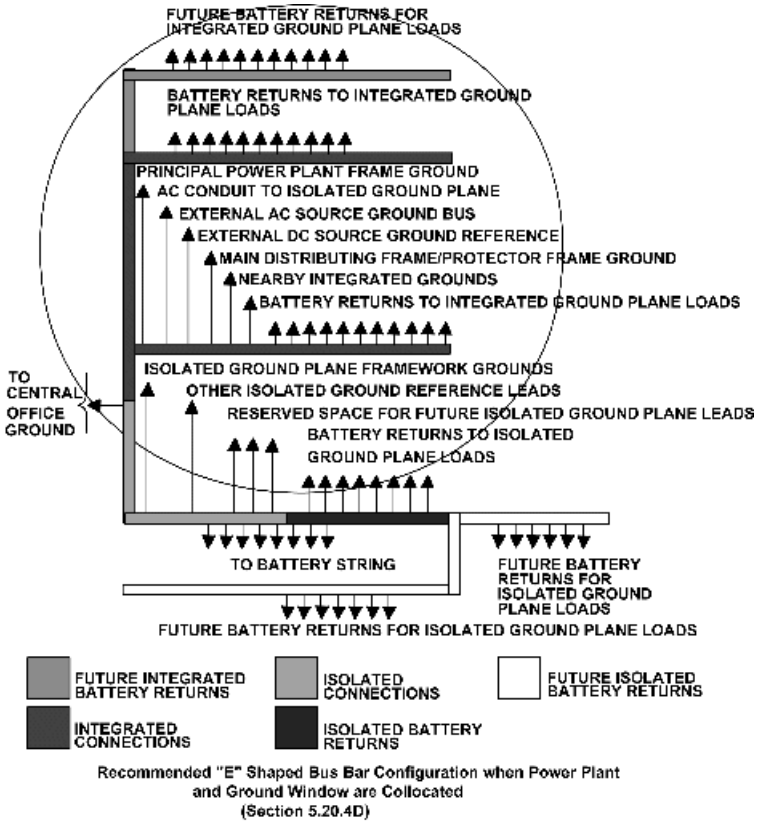
Recommended "C" Shaped Bus Bar Configuration when Power Plant and Ground Window are Collocated
(Section 5.20.4D)

Figure 38.



Recommended "C" Shaped Bus Bar Configuration when Power Plant and Ground Window are NOT Collocated
(Section 5.20.4D)

Figure 39.



Recommended "E" Shaped Bus Bar Configuration when Power Plant and Ground Window are Collocated (Section 5.20.4D)

Figure 40.

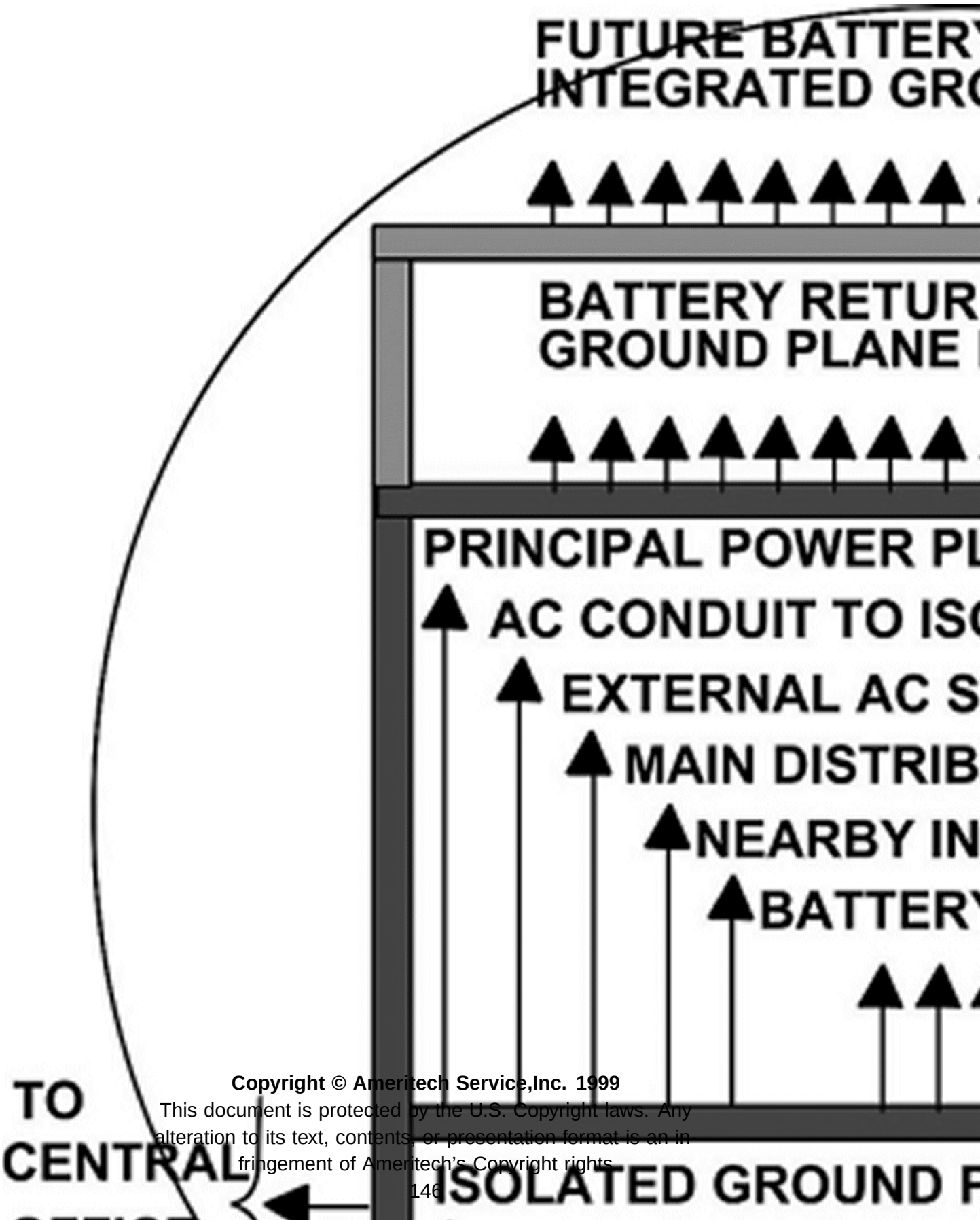
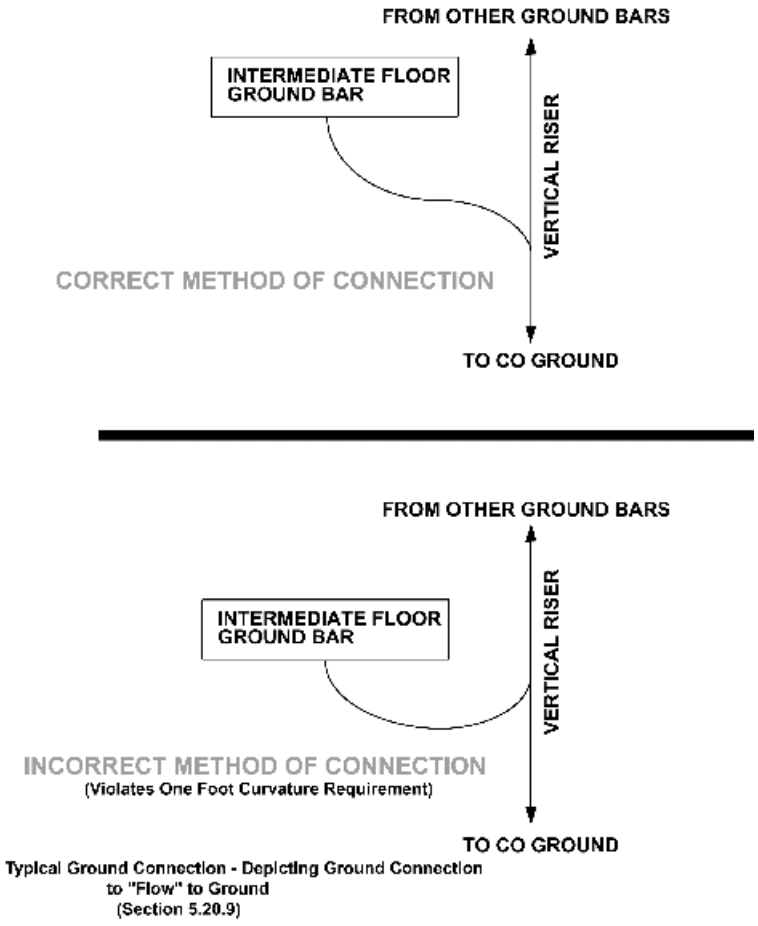


Figure 41.



Typical Ground Connection - Depicting Ground Connection to "Flow" to Ground (Section 5.20.9)

Figure 42.

Daily Work Log

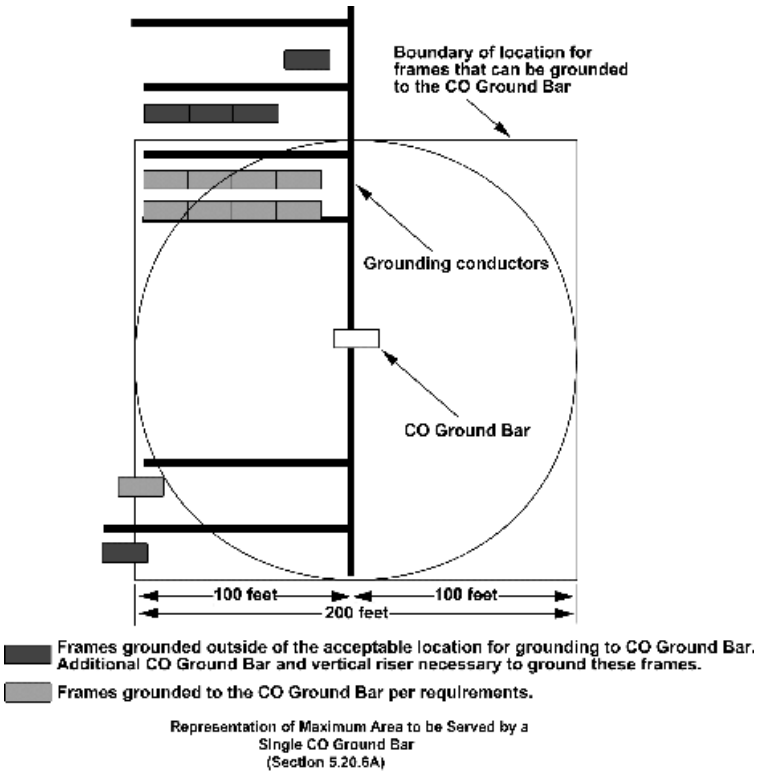
REMOVAL/CABLE MINING ACTIVITY

TOWN/OFFICE _____ TELCO ORDER# _____
VENDOR _____ VENDOR ORDER# _____

DATE/ TIME	NAME	WORK LOCATION	WORK ACTIVITY

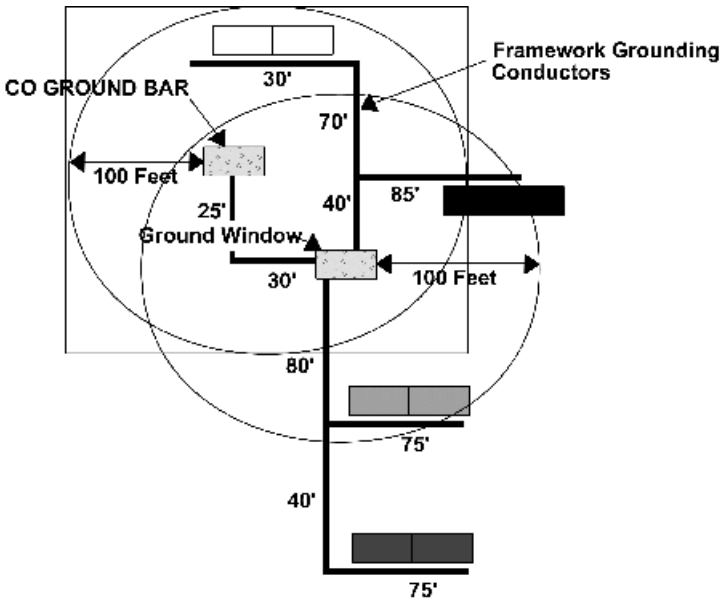
Sample Daily Work Log (Section 2.2.4F)

Figure 43.



Representation of Maximum Area to be Served by a Single CO Ground Bar
(Section 5.20.6A)

Figure 44.

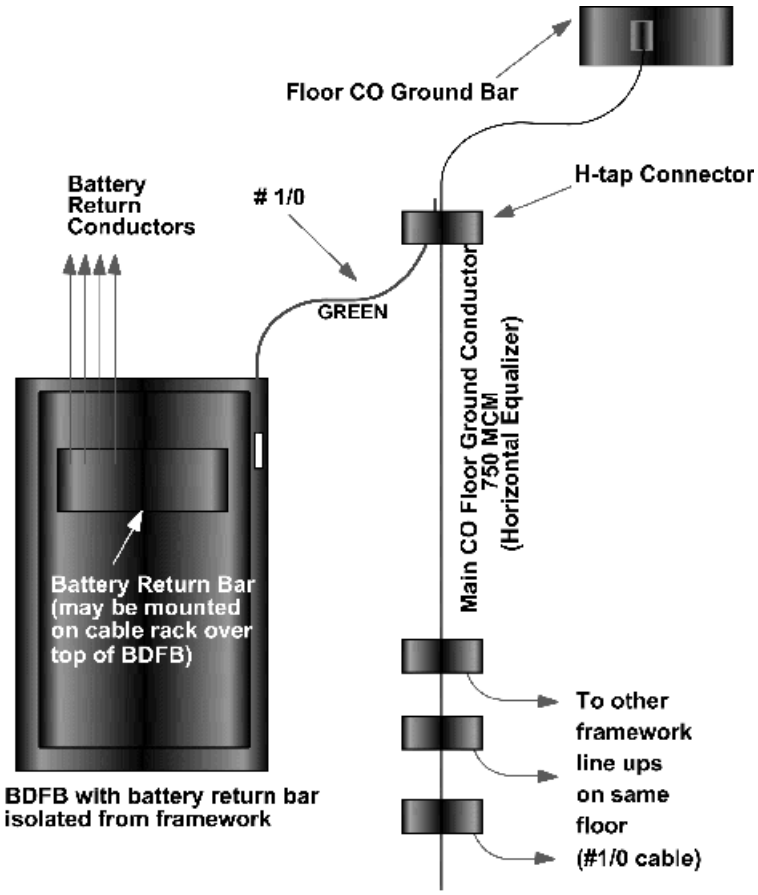


Isolated Ground Plane Frames

- Acceptable location - within 100 straight line feet of ground window and 200 conductor feet of the CO ground bar (25' + 30' + 40' + 85' = 180').
- Unacceptable location - even though within 100 straight line feet of ground window, the furthest point is more than 200 conductor feet of the CO ground bar (25' + 30' + 80' + 75' = 210').
- Unacceptable location - more than 100 straight line feet of ground window and more than 200 conductor feet of the CO ground bar (25' + 30' + 80' + 40' + 75' = 250').
- Unacceptable location - even though within 200 conductor feet of the CO ground bar (25' + 30' + 40'+ 70' + 30' = 195'), distance is over 100 feet of the CO ground window.

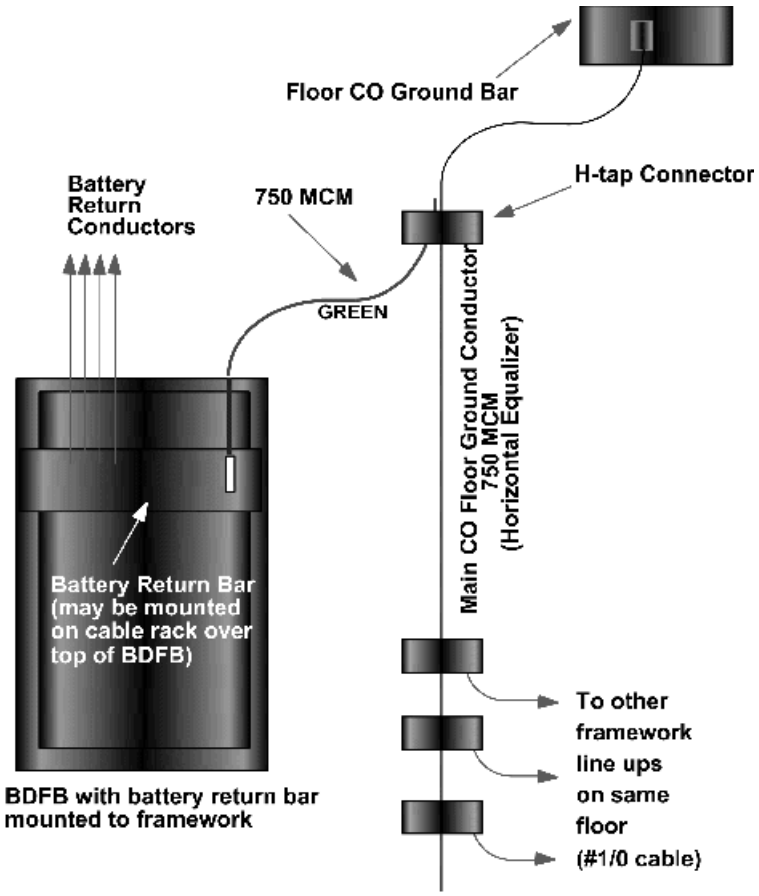
Representation of Maximum Area to be served by a Ground Window in Relationship to the CO Ground Bar
(Section 5.20.6B)

Figure 45.



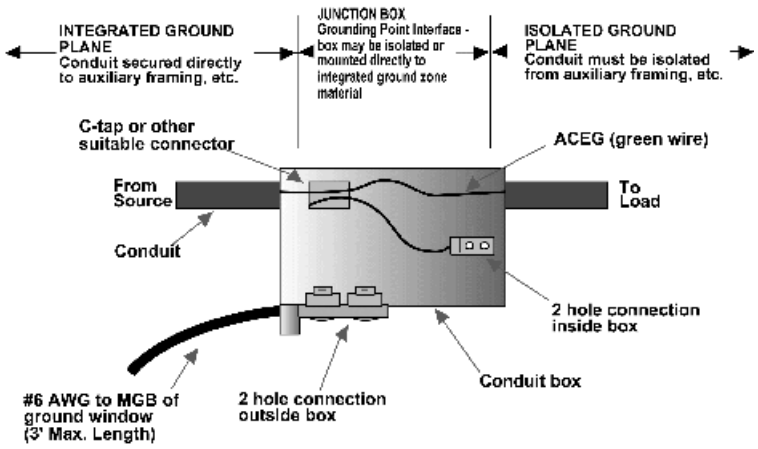
Framework Grounding Requirements for BDFB with Battery Return Bar Isolated from Framework (Section 5.20.3C)

Figure 46.



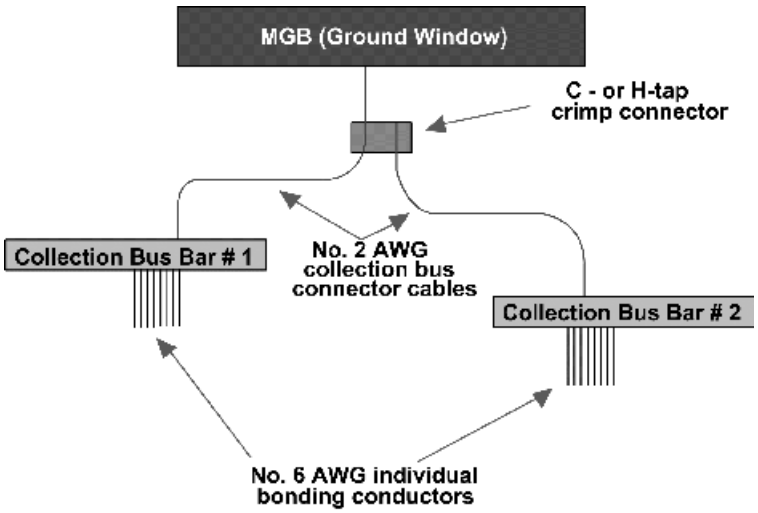
Framework Grounding Requirements for BDFB with Battery Return Bar Mounted to Framework
(Section 5.20.3D)

Figure 47.



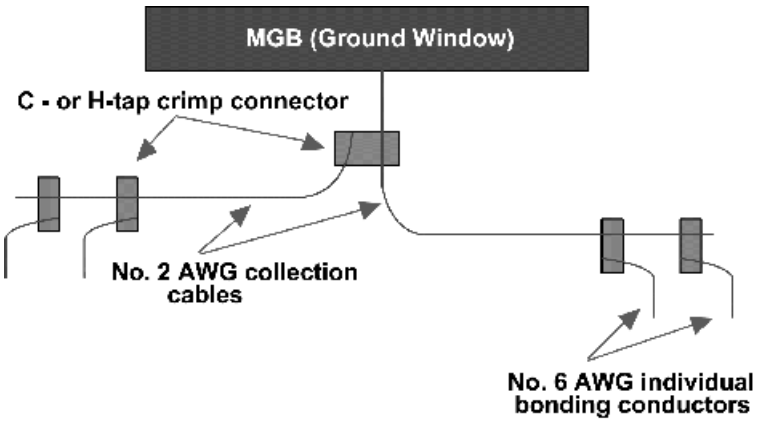
Typical Method to Bond ACEG to AC Conduit Entering the Isolated Ground Plane (Section 5.20.10C)

Figure 48.



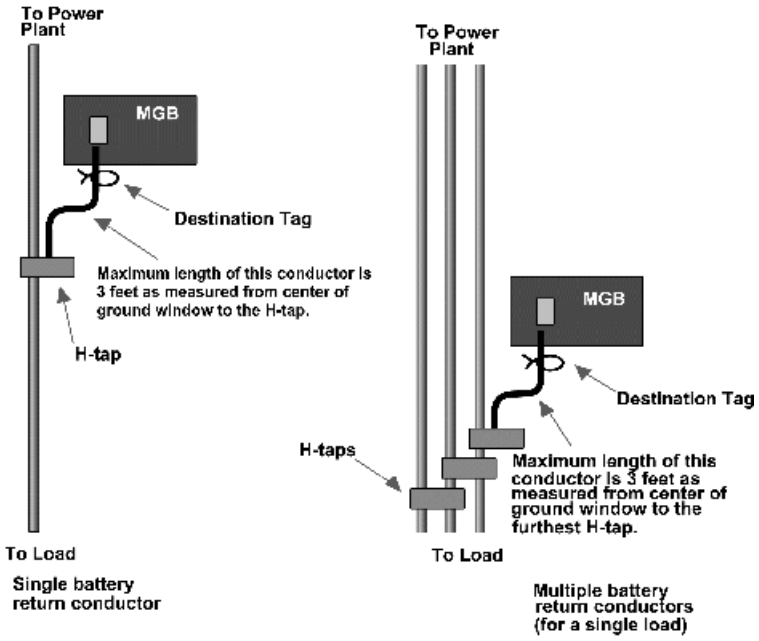
Alternative Method to Connect Several Collection Bus Bars to the Ground Window (Section 5.20.13A)

Figure 49.



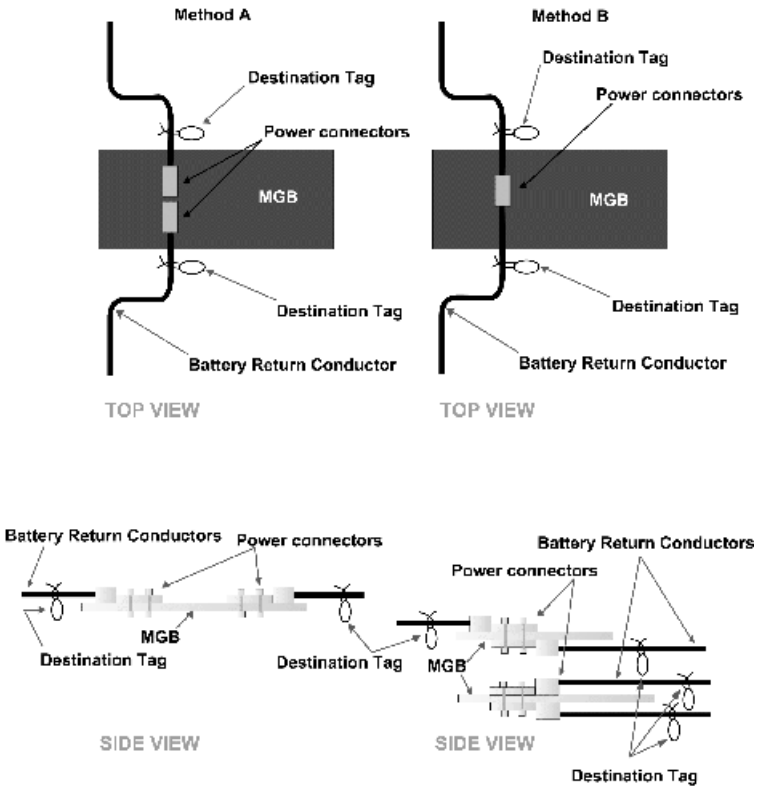
Alternative Method to Connect Several Collection Cables to the Ground Window
(Section 5.20.13C)

Figure 50.



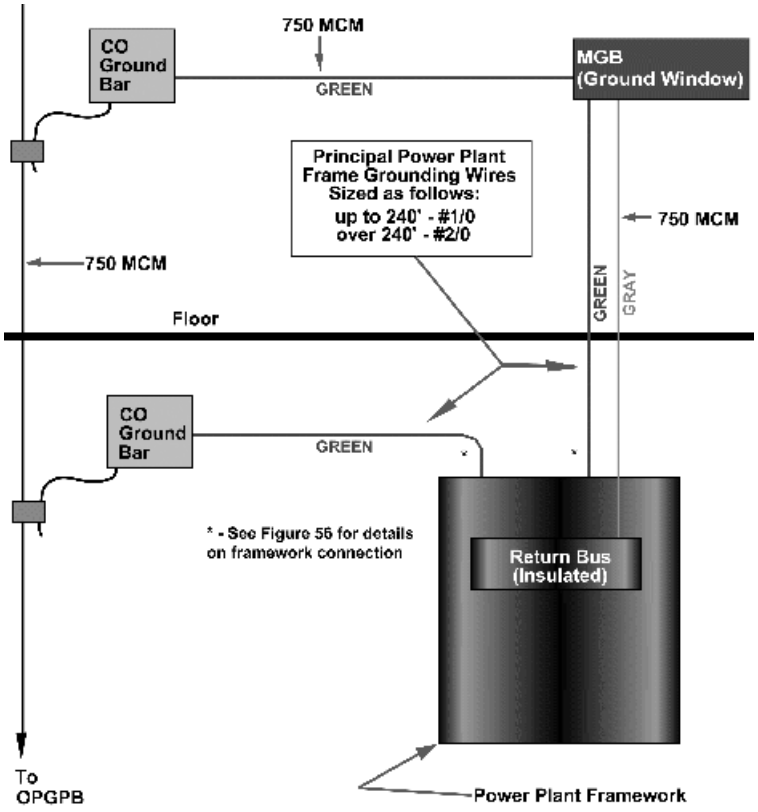
Preferred Method to Bond Battery Return Leads to the MGB when the Ground Window and Power Plant are NOT Collocated
(Sections 5.20.14 and 5.41.11)

Figure 51.



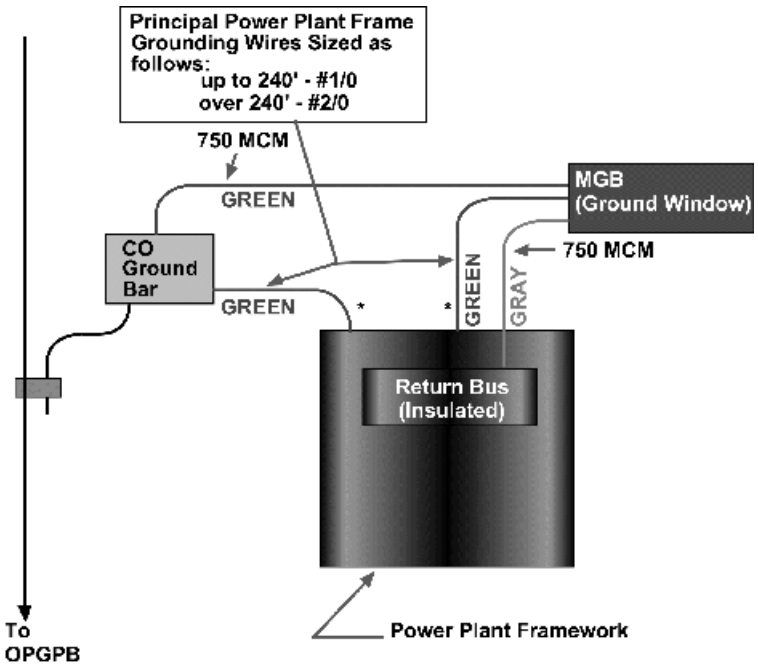
Acceptable Method to bond Battery Return Leads to the MGB when the Ground Window and Power Plant are **NOT** Collocated
(Sections 5.20.14B and 5.41.11)

Figure 52.



Power Plant Framework Grounding Conductors Required when the MGB and the Power Plant are NOT Collocated (Different Floors)
(Section 5.20.18A)

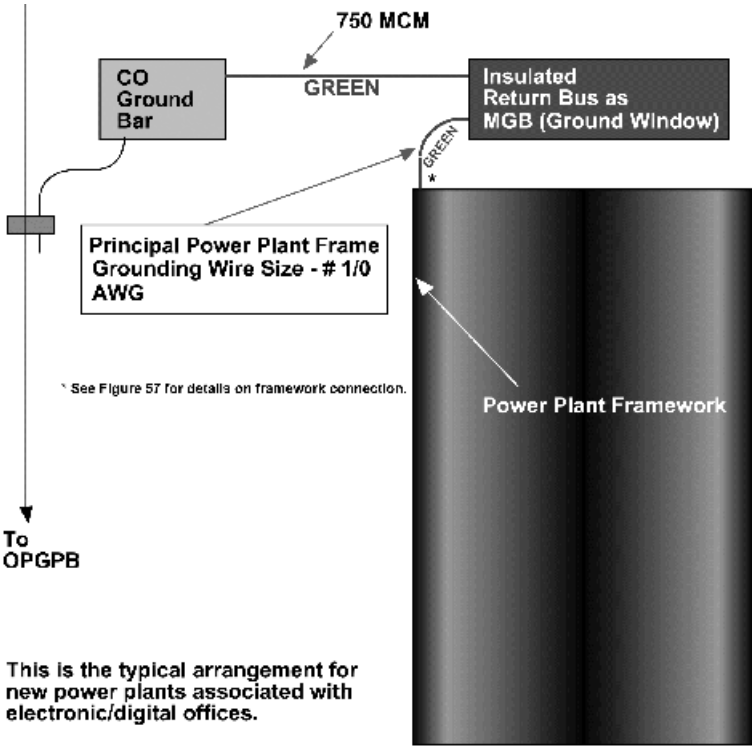
Figure 53.



* - See Figure 56 for details on framework connection.

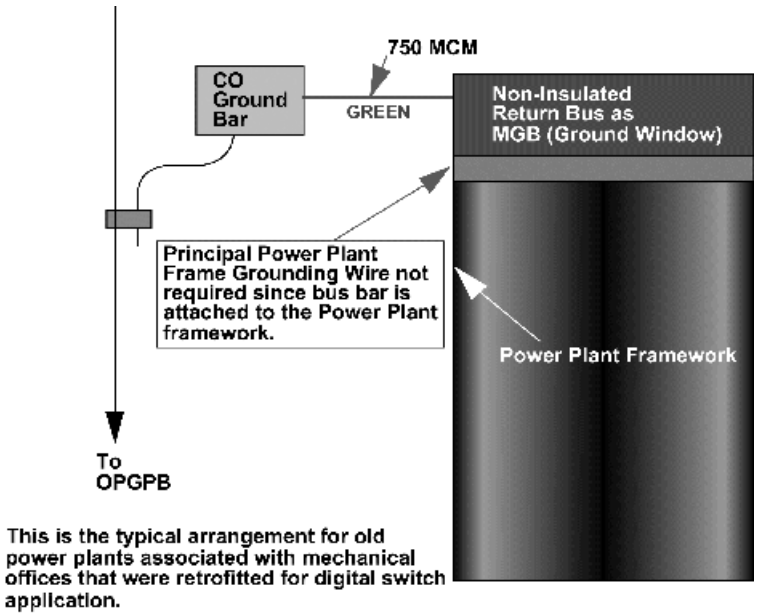
Power Plant Framework Grounding Connection Required when the MGB and Power Plant are NOT Collocated (Same Floor)
(Section 5.20.18B)

Figure 54.



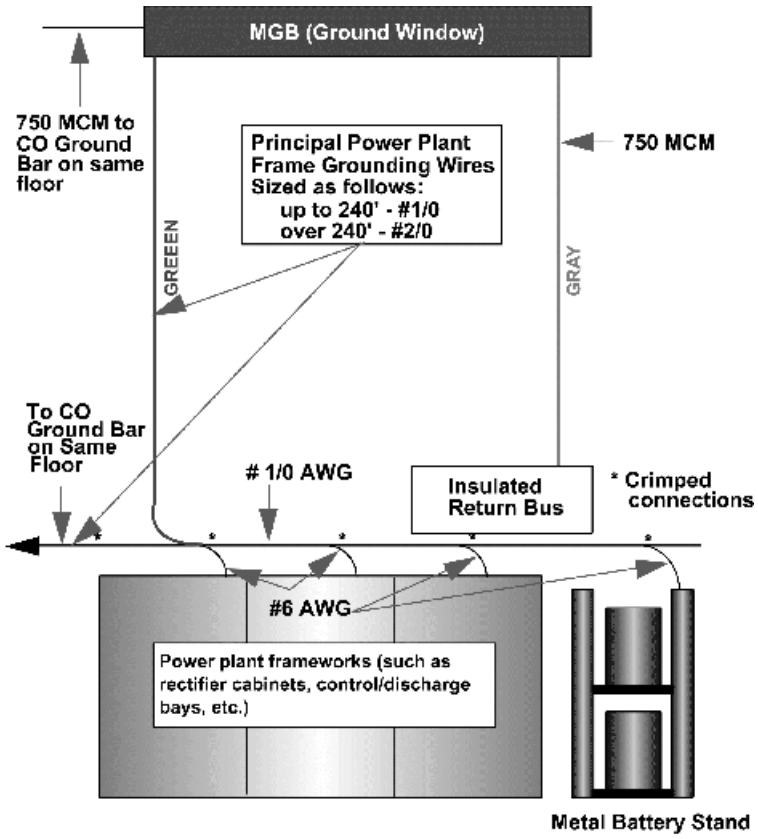
Power Plant Framework Grounding Conductors Required when the MGB and Power Plant are Collocated (Same Floor)
(Section 5.20.18C)

Figure 55.



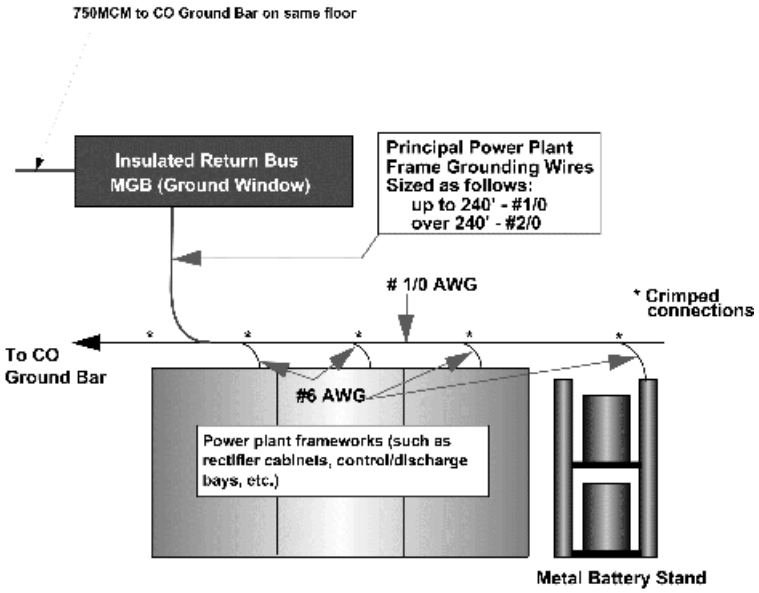
Power Plant Framework Grounding Conductors Required when the MGB and the Power Plant are Collocated (Same Floor)
(Section 5.20.18D)

Figure 56.



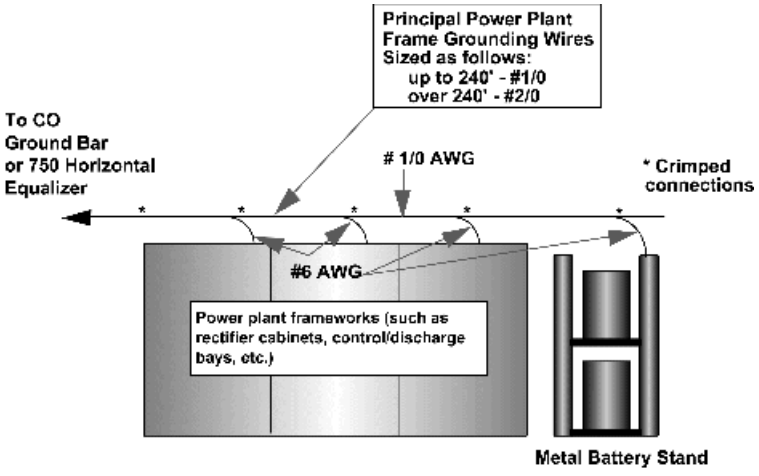
Connection Point for Power Plant Grounding Conductor when the MGB and the Power Plant are NOT Collocated
(Sections 5.20.18A and 5.20.18B)

Figure 57.



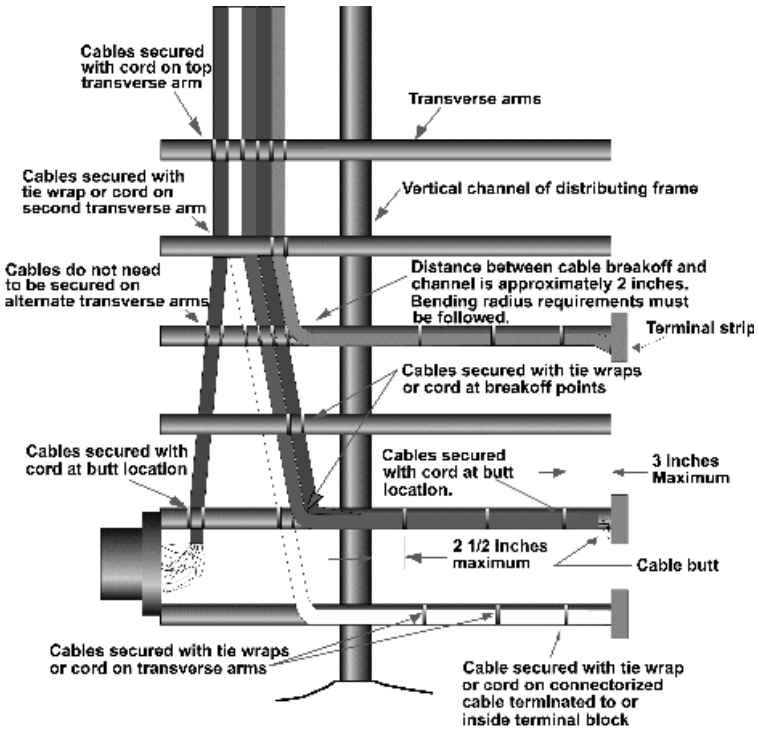
Connection Point for Power Plant Grounding Conductor with a Collocated MGB
(Section 5.20.18C)

Figure 58.



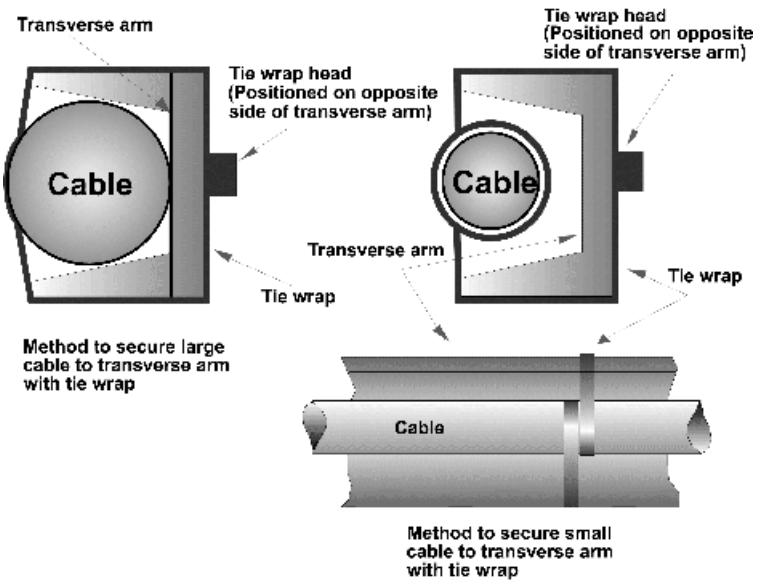
Dedicated DTE Power Plant - No Ground Window is Required
(Section 5.20.18)

Figure 59.



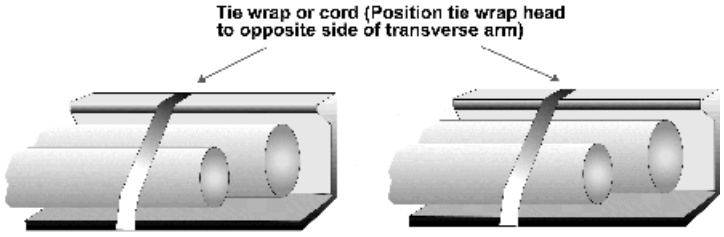
Side View of Conventional Distribution Frame - Cable Securing Methods
(Sections 5.14.3. 5.14.3B, and 5.14.4E)

Figure 60.



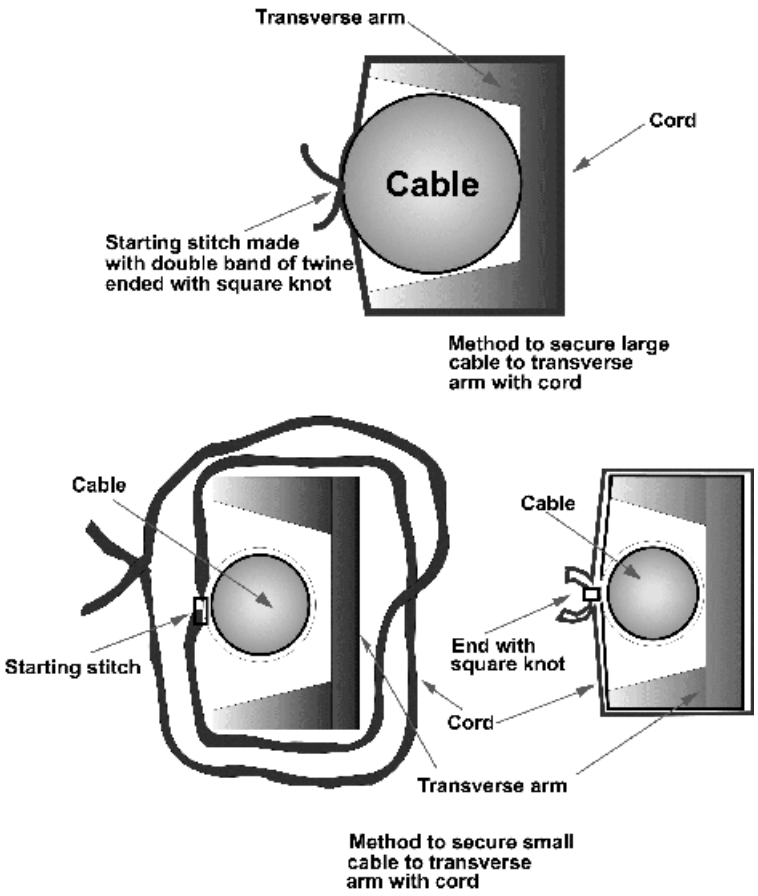
Method of Securing Cables to Transverse Arms with Tie Wraps
(Sections 5.14.3, and 5.14.4E)

Figure 61.



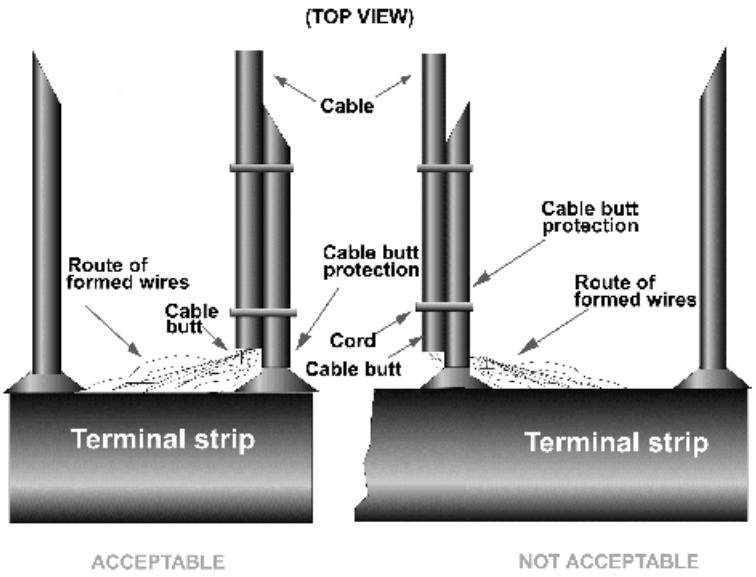
Method of Securing Several Cables to Transverse Arms
(Sections 5.14.3, and 5.14.4E)

Figure 62.



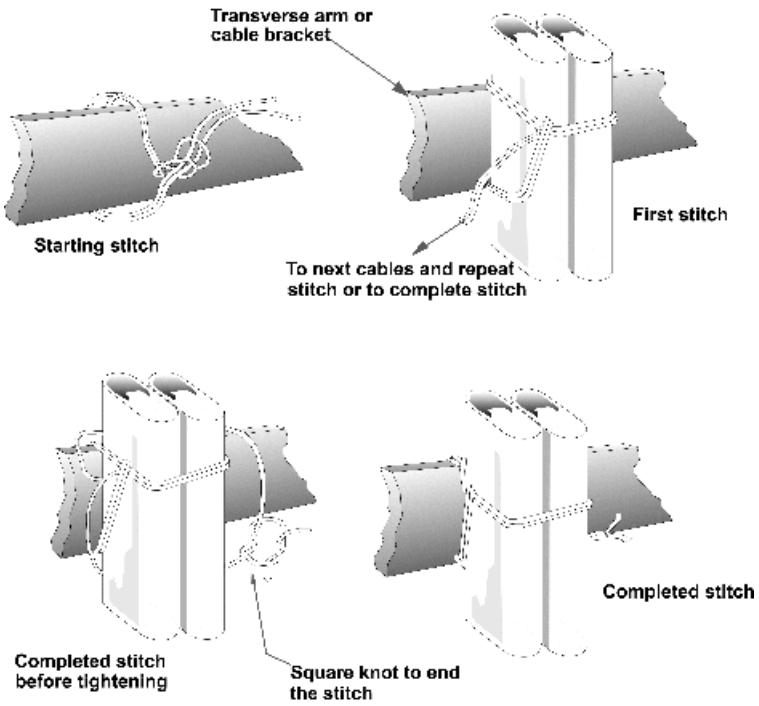
Method of Securing Cable to Transverse Arms with Lacing Cord
(Section 5.14.3)

Figure 63.



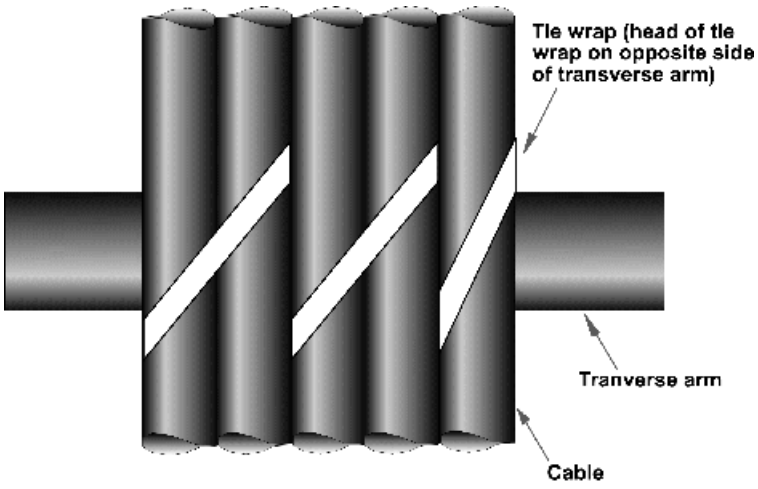
Method of Forming Leads on Horizontal Side of Distributing Frame
(Sections 5.14.3, and 5.14.3C)

Figure 64.



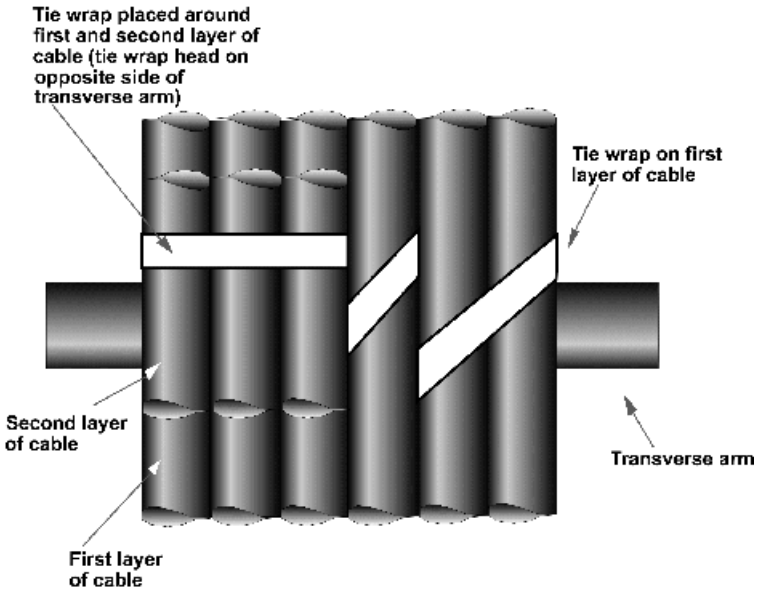
Method of Securing Cable with Cord to Cable Brackets In Frames or to any Vertical Transverse Arm
(Sections 5.14.3 and 5.14.5)

Figure 65.



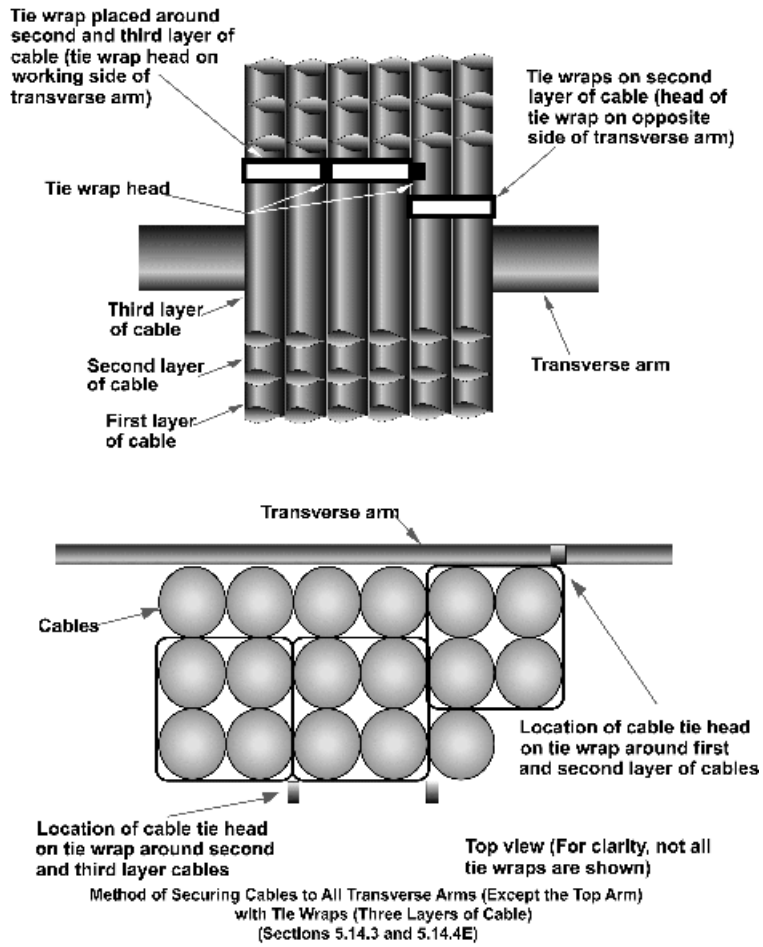
Method of Securing Cables to All Transverse Arms (Except to the Top Arm) with Tie Wraps (Single Layer of Cable)
(Sections 5.14.3 and 5.144E)

Figure 66.



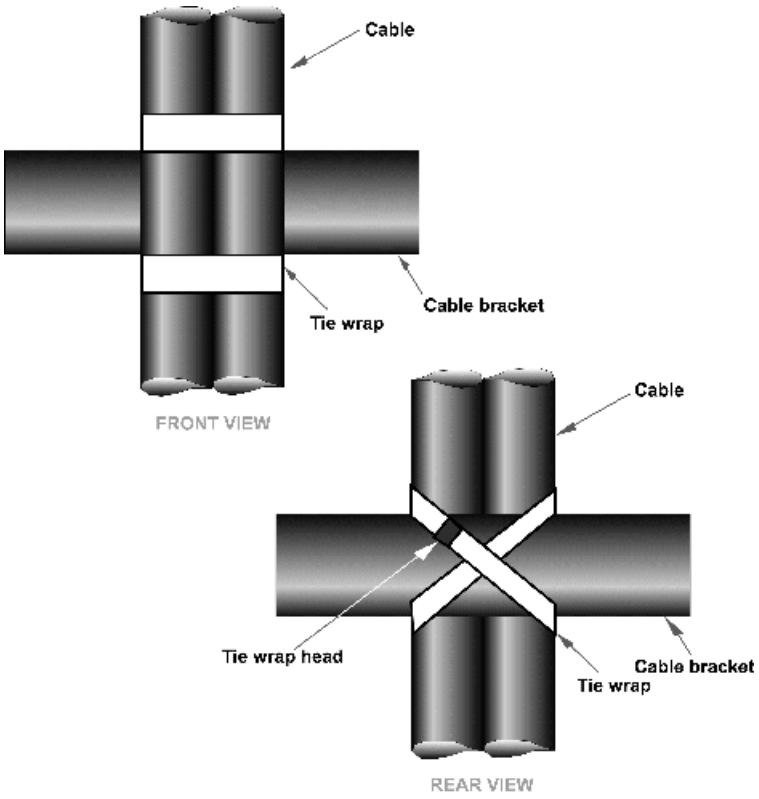
Method of Securing Cables to All Transverse Arms (Except the Top Arm) with Tie Wraps (Two Layers of Cable)
(Sections 5.14.3 and 5.14.4E)

Figure 67.



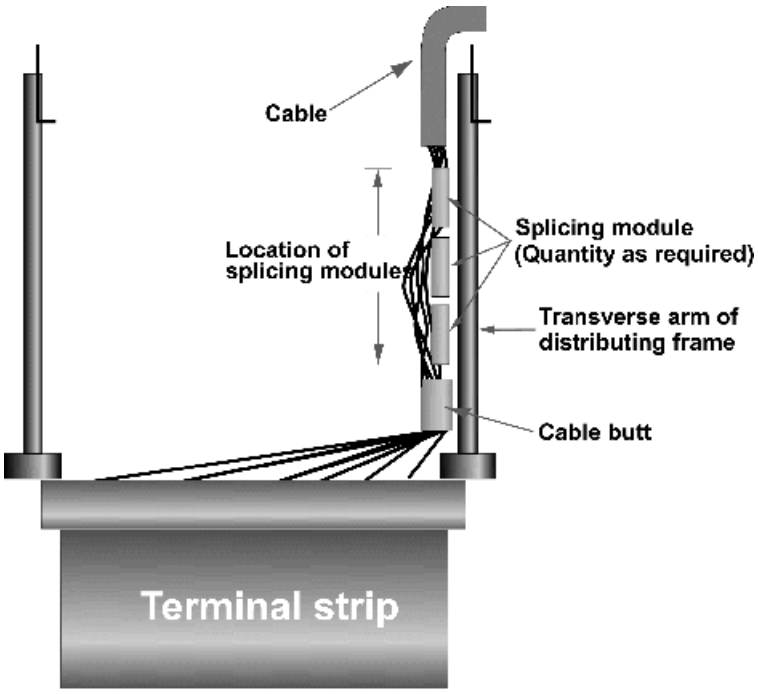
Method of Securing Cables to All Transverse Arms (Except the Top Arm) with Tie Wraps (Three Layers of Cable) (Sections 5.14.3 and 5.14.4E)

Figure 68.



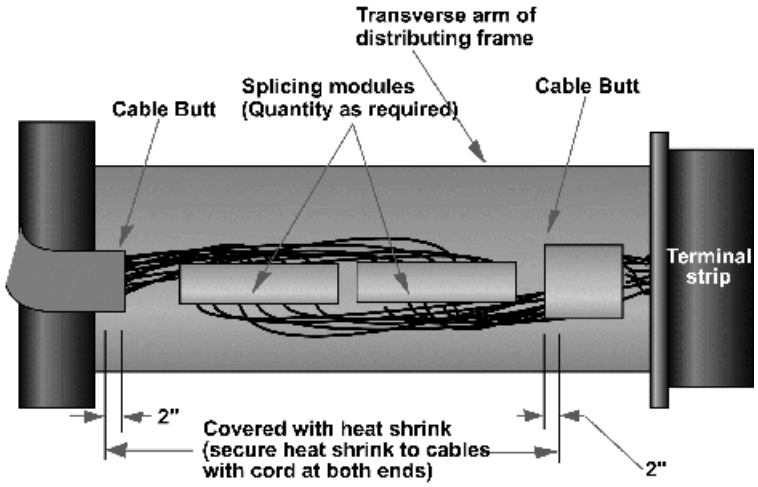
Method of Securing Cable with Tie Wraps to Cable Brackets in Frames
(Section 5.14.5)

Figure 69.



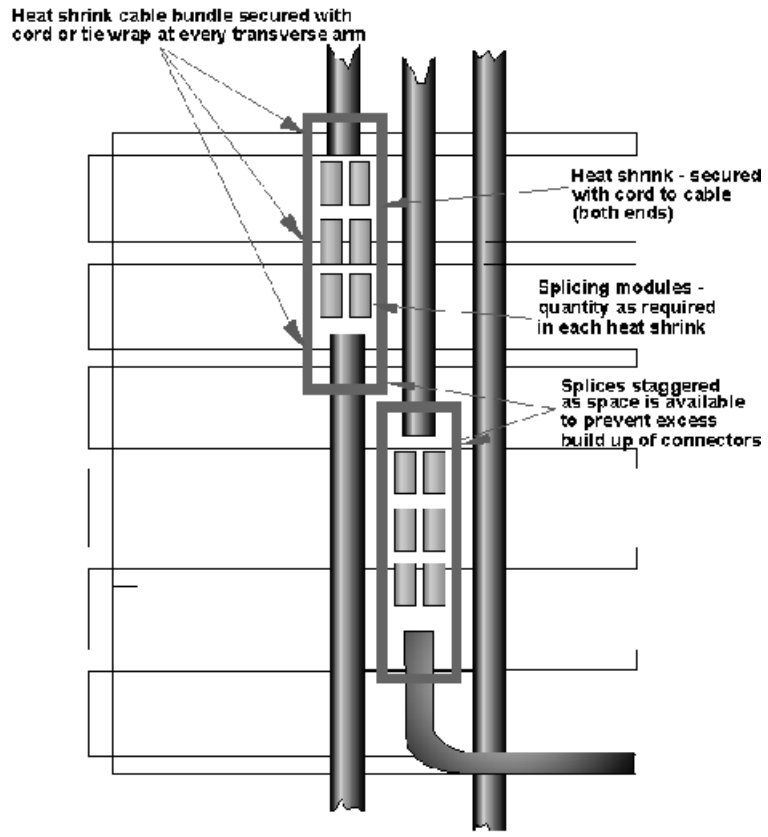
Location of Splicing Modules on a Conventional Distributing Frame - Horizontal Side (Top View) (Section 5.25.3)

Figure 70.



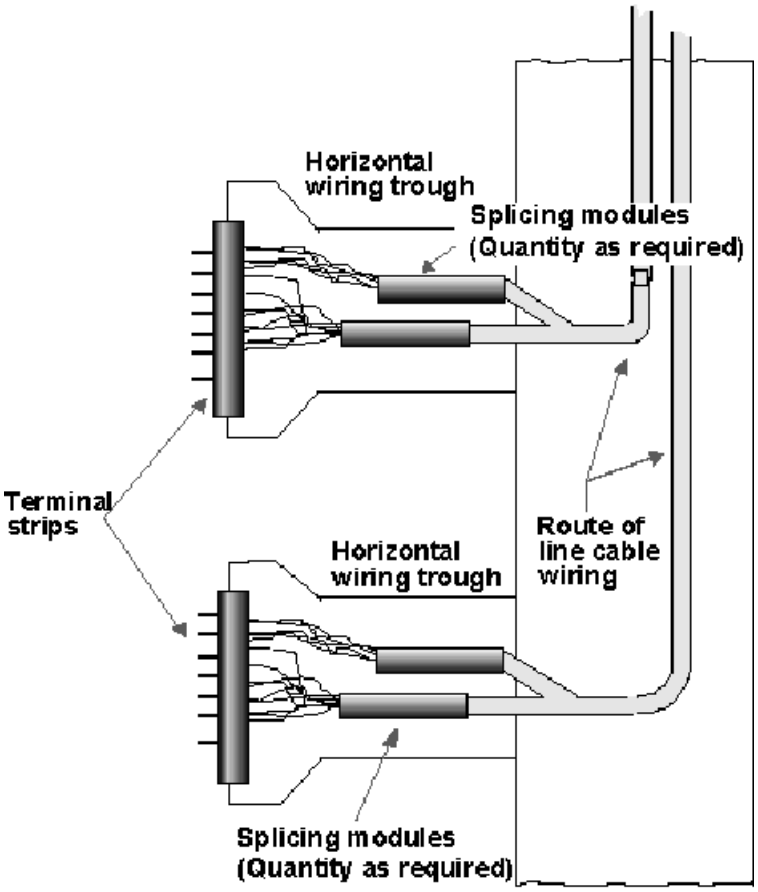
Location of Splicing Modules on a Conventional Distributing Frame - Horizontal Side (Side View) (Sections 5.25.3A and 5.25.3B)

Figure 71.



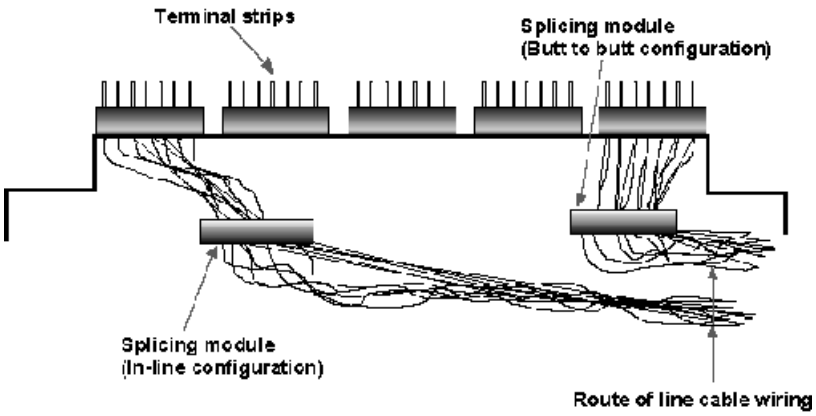
Location of Splicing Module on a Conventional Distributing Frame
Vertical Side (Side View)
(Sections 5.25.3, 5.25.3A, and 5.25.3B)

Figure 72.



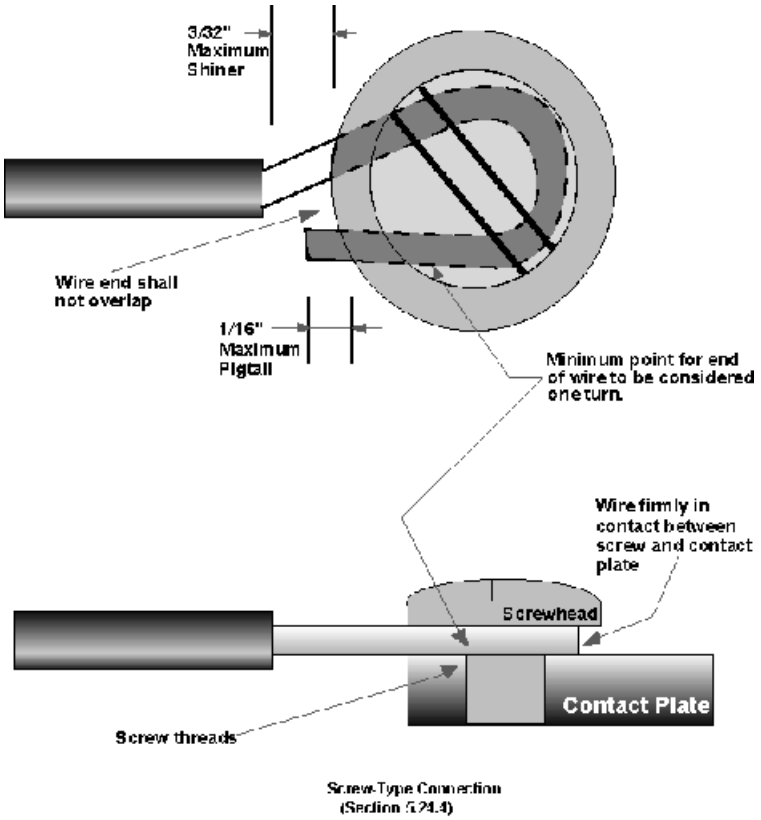
Location of Splicing Module on a COSMIC
Distributing Frame (Side View)
(Section 5.25.4)

Figure 73.



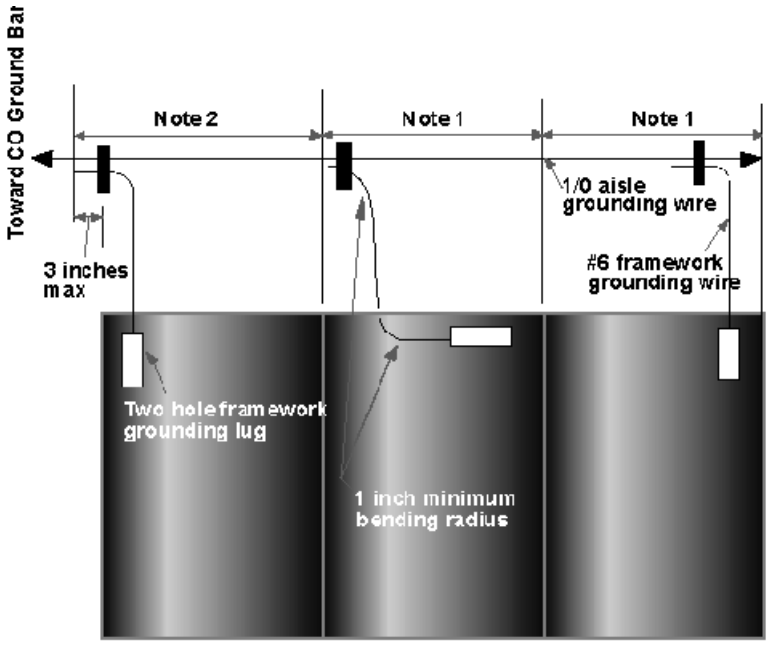
Location of Splicing Module on a COSMIC
Distributing Frame (Top View)
(Section 5.25.4)

Figure 74.



Screw-Type Connection
(Section 5.24.4)

Figure 75.



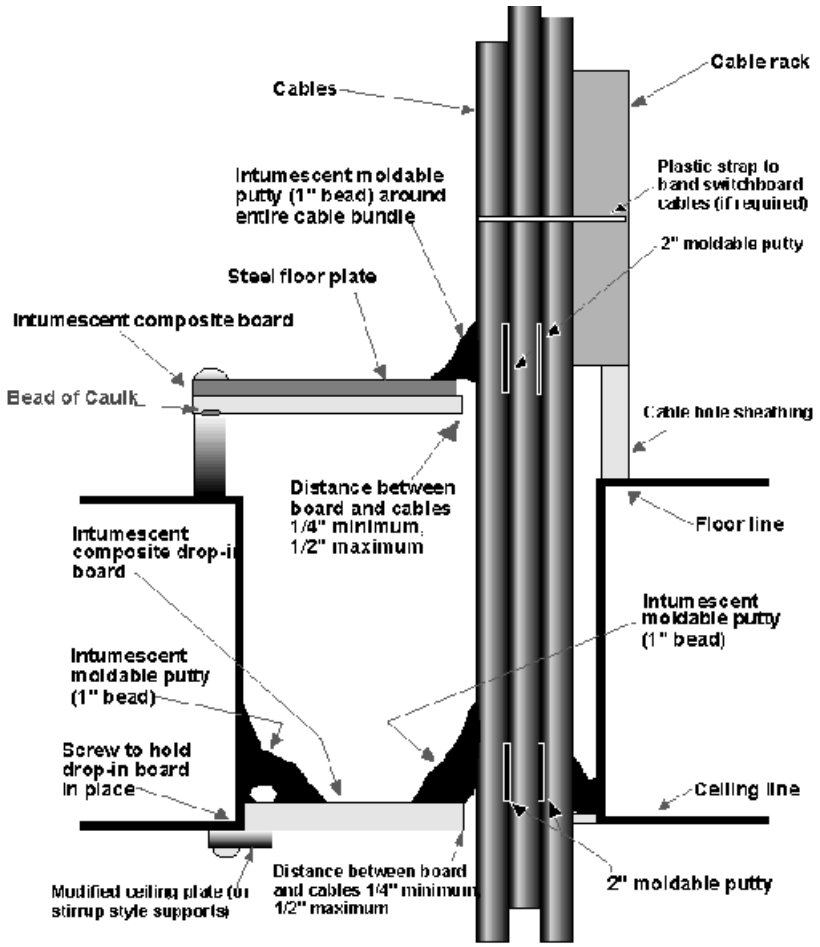
Note 1 - The C-tap or H-tap connector should be within the vertical plane of the framework being grounded

Note 2 - The C-tap or H-tap connector may be over an adjacent frame when the framework grounding connection is located on the upright toward the CO ground bar

Note 3 - The #6 framework grounding cable shall not be intermixed with power or switchboard cable entering the bay.

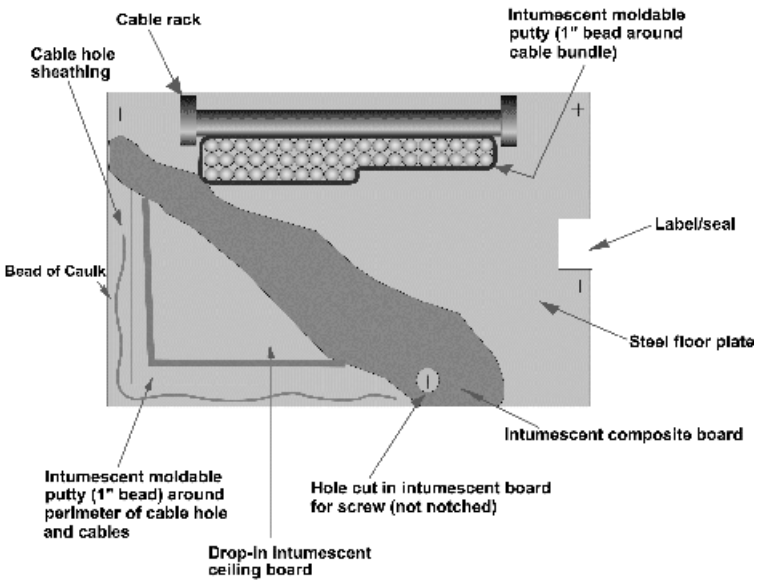
Framework Bonding Requirements - Typical Configuration
(Section 5.20.9)

Figure 76.



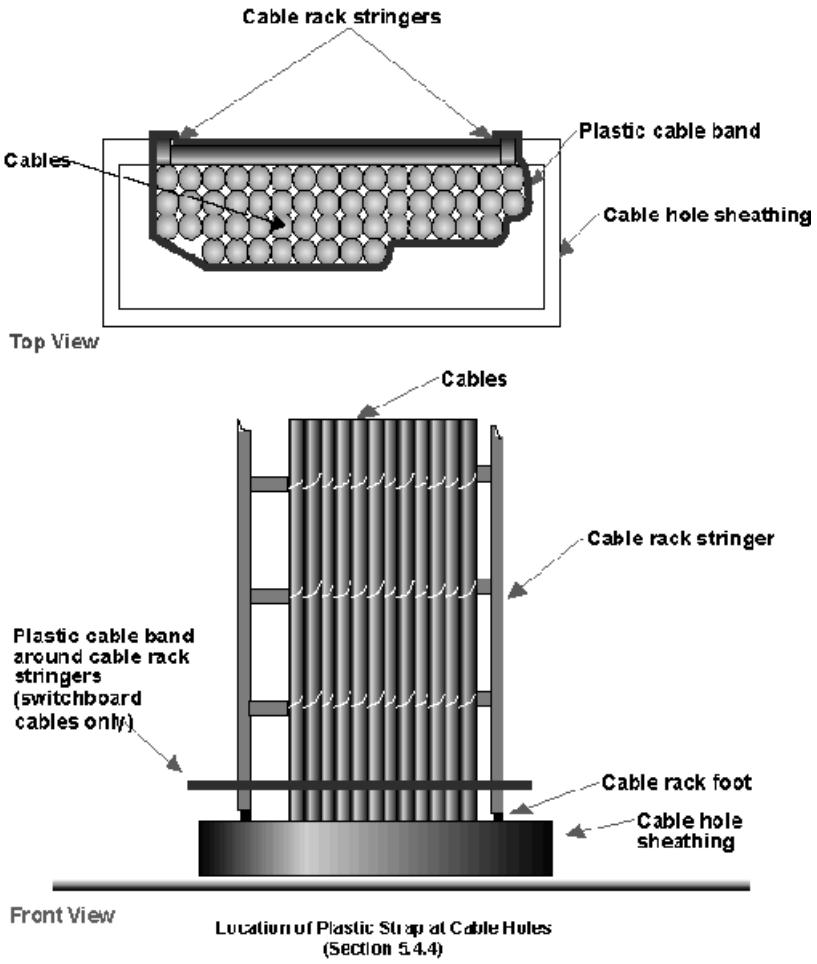
Side View of Cable Hole Closure in Floor
(Section 5.4.4)

Figure 77.



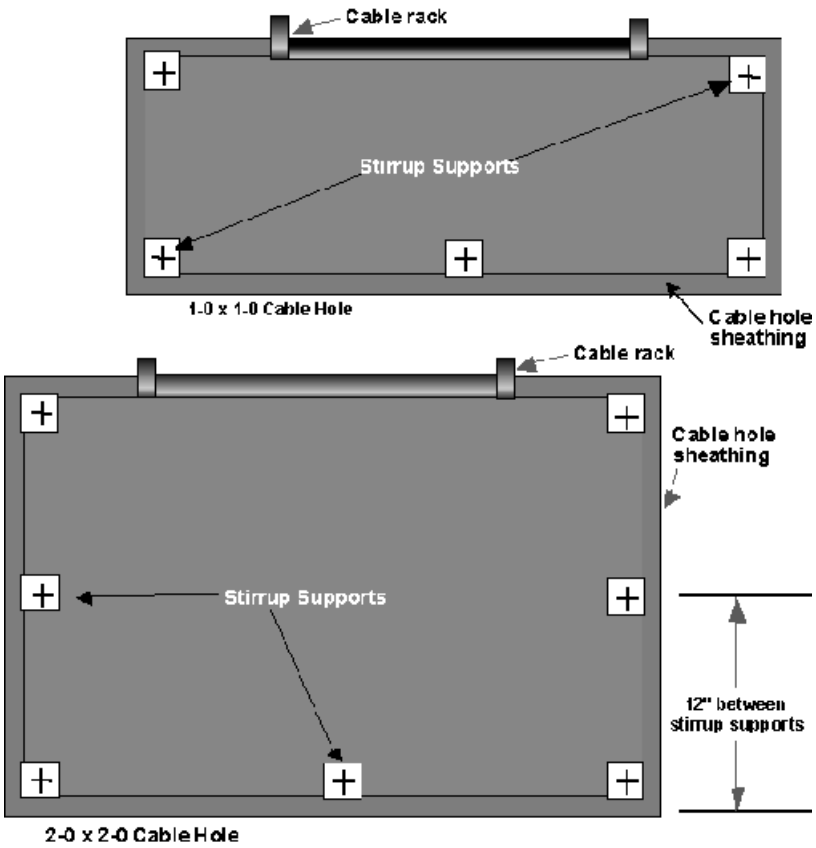
Top View of Cable Hole Closure in Floor
(Section 5.4.4)

Figure 78.



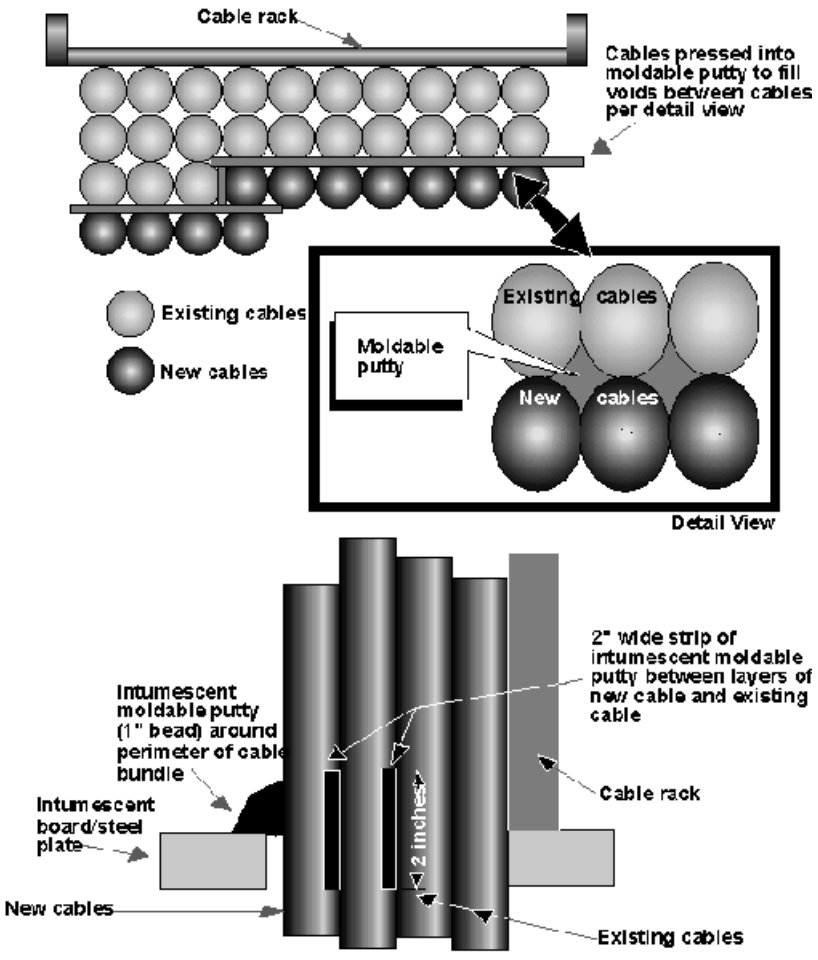
Location of Plastic Strap at Cable Holes
(Section 5.4.4)

Figure 79.



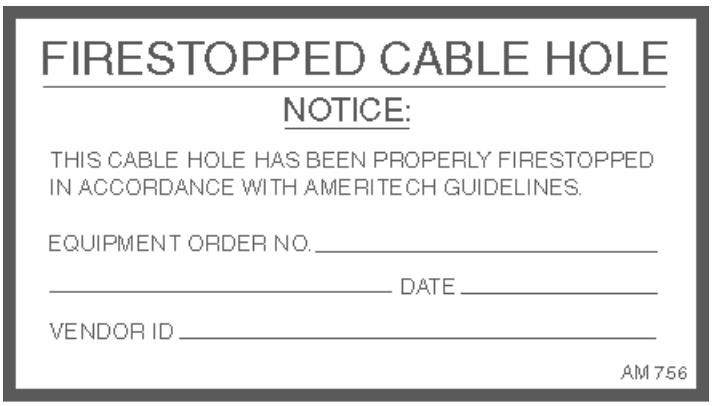
Location of Stirrup Style Supports for Drop-In Intumescent Composite Board
(Section 5.4.4B)

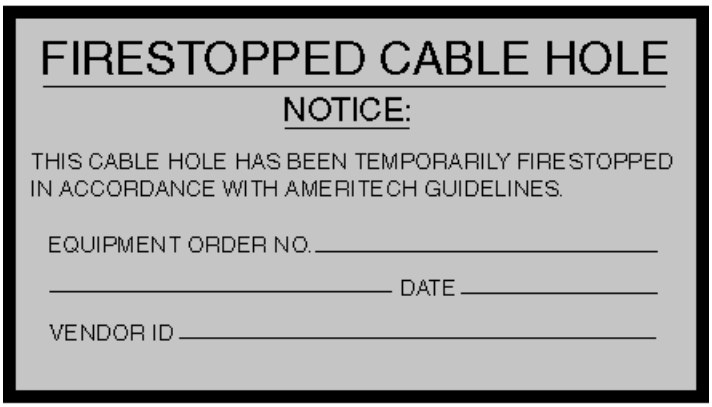
Figure 80.



Adding Putty Between Cables on NEW Cable Runs
(Sections 5.4.4E and 5.4.5D)

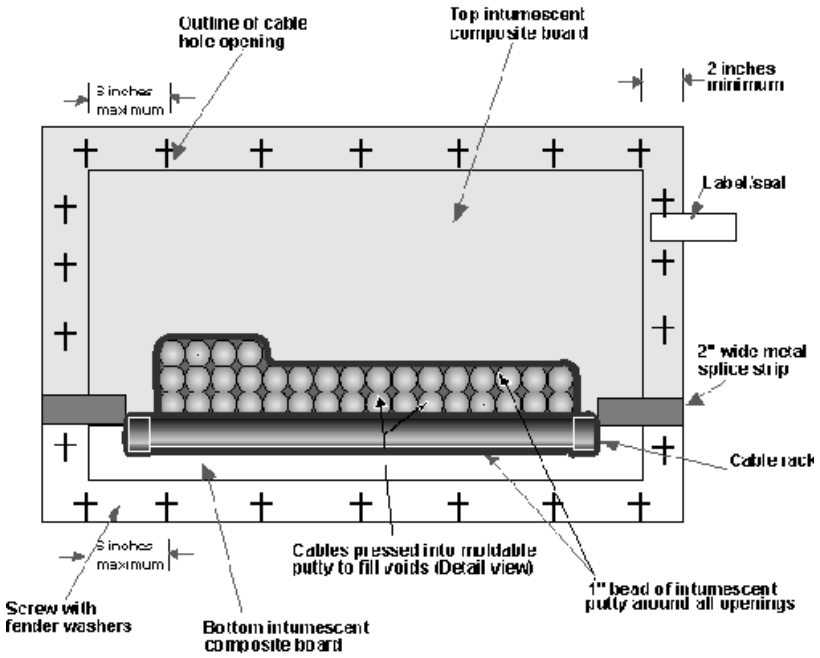
Figure 81.





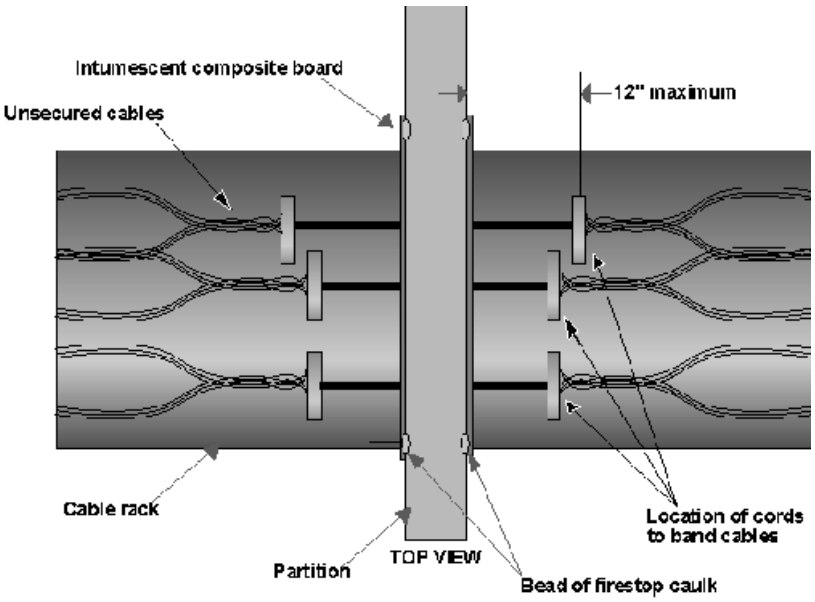
Typical Label/Seal Used on Fire Stopped Cable Holes
(Sections 5.4.4F and 5.4.5F)

Figure 82.



Cable Hole Closure in Wall
(Section 5.4.5)

Figure 83.



Unsecured Cables Through a Partition
(Section 5.4.5E)

Figure 84.

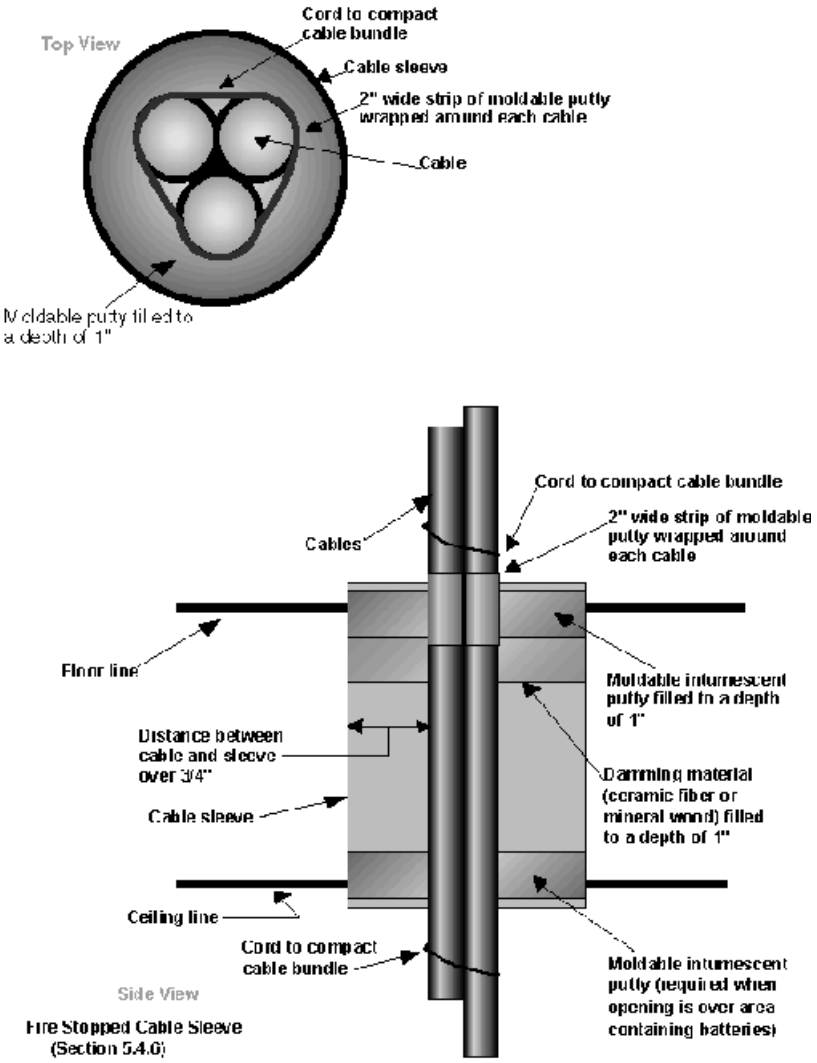
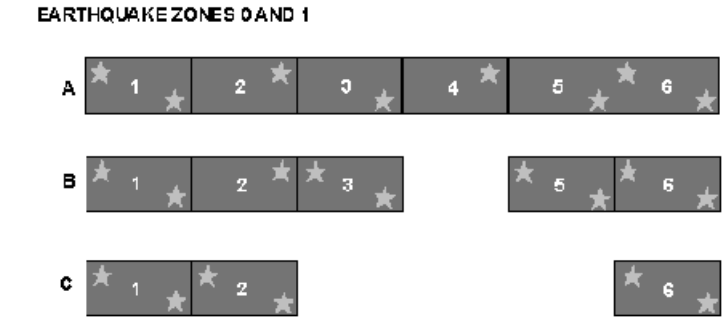


Figure 85.

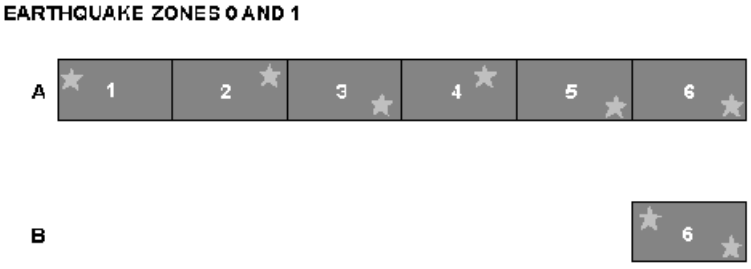


★ = Anchor bolt location

1. In line-up "A", bays 1 and 6 are end frames in a line-up and require two anchor bolts.
2. In line-up "B", bays 1, 3, 5 and 6 are end frames in a line-up and require two anchor bolts.
3. In line-up "C", bays 1 and 2 are end frames in line-up and bay 6 is an isolated bay in a line-up. All three bays require two anchor bolts

Anchor Bolt Pattern for Securing Frames in a Lineup
for Earthquake Zones 2 and 3
(Sections 5.11.2E, 5.11.2F, 5.11.2I, and 5.11.2J)

Figure 86.

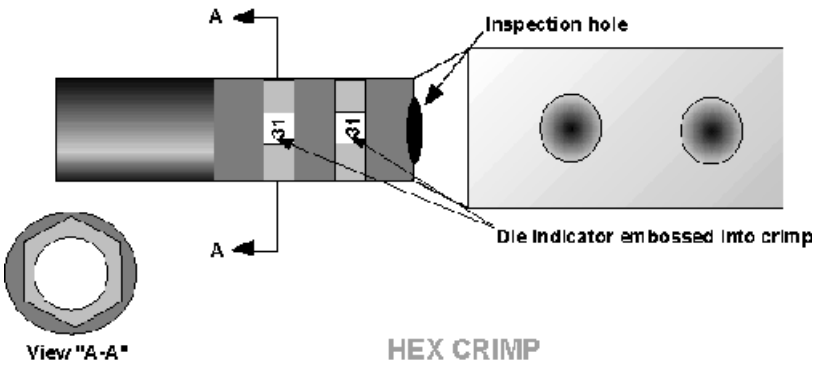


★ = Anchor bolt location

1. In line-up "A", bays 1 and 6 require one anchor bolt.
2. In line-up "B", bay 6 is an isolated bay in a line-up and requires 2 anchor bolts.

Anchor Bolt Pattern for Securing Frames in a Lineup
for Earthquake Zones 0 and 1
(Sections 5.11.2A, 5.11.2B, 5.11.2.C and 5.11.2D)

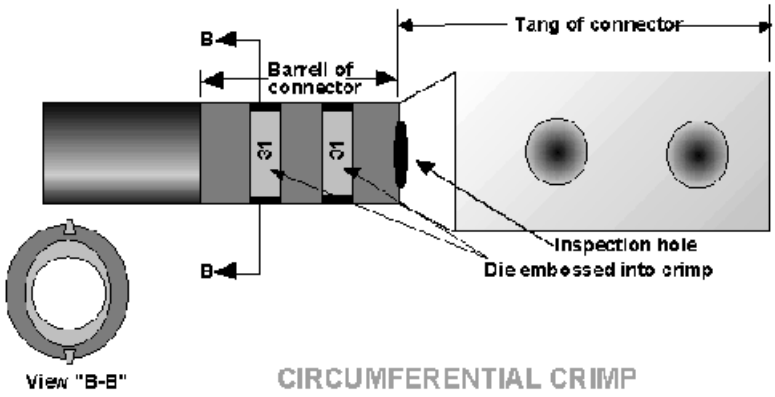
Figure 87.



HEX CRIMP

After crimping, all flashes, burrs, or sharp edges resulting from the crimping process must be removed

Compression Connectors - Crimp Types
(Section 5.30.1)



CIRCUMFERENTIAL CRIMP

Figure 88.

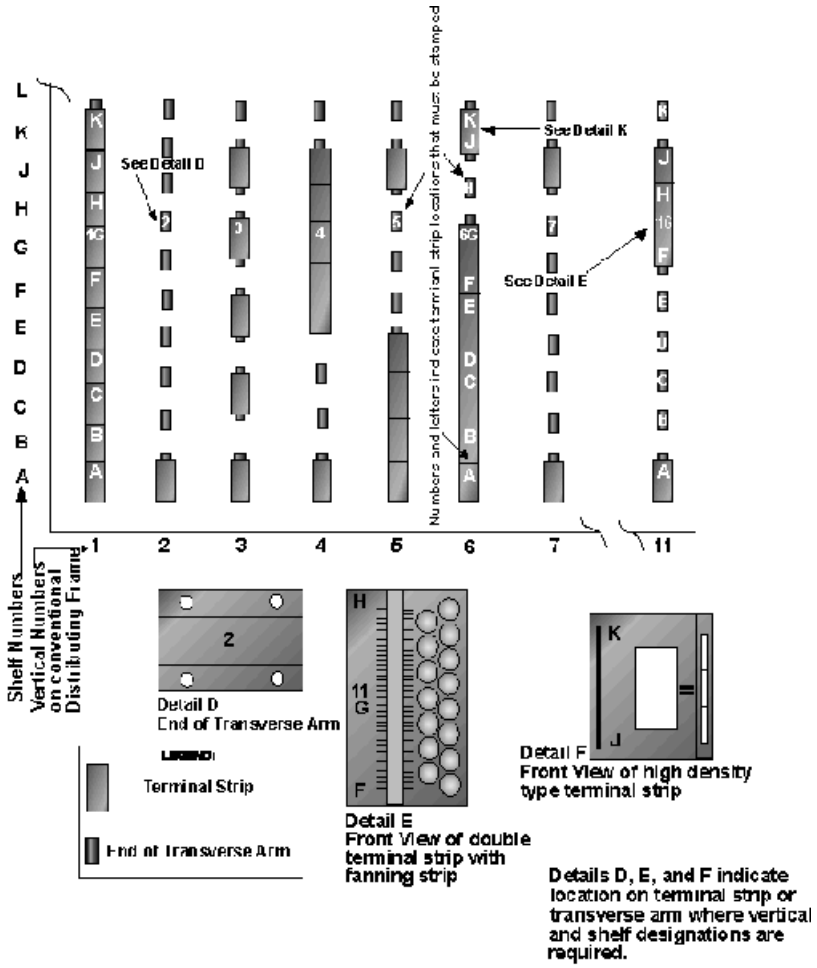
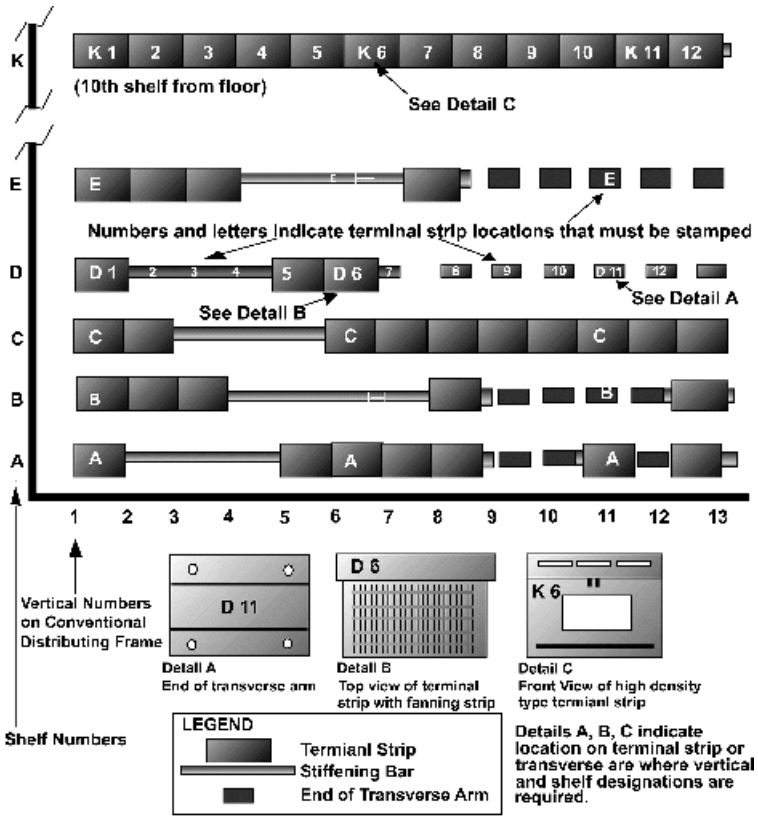
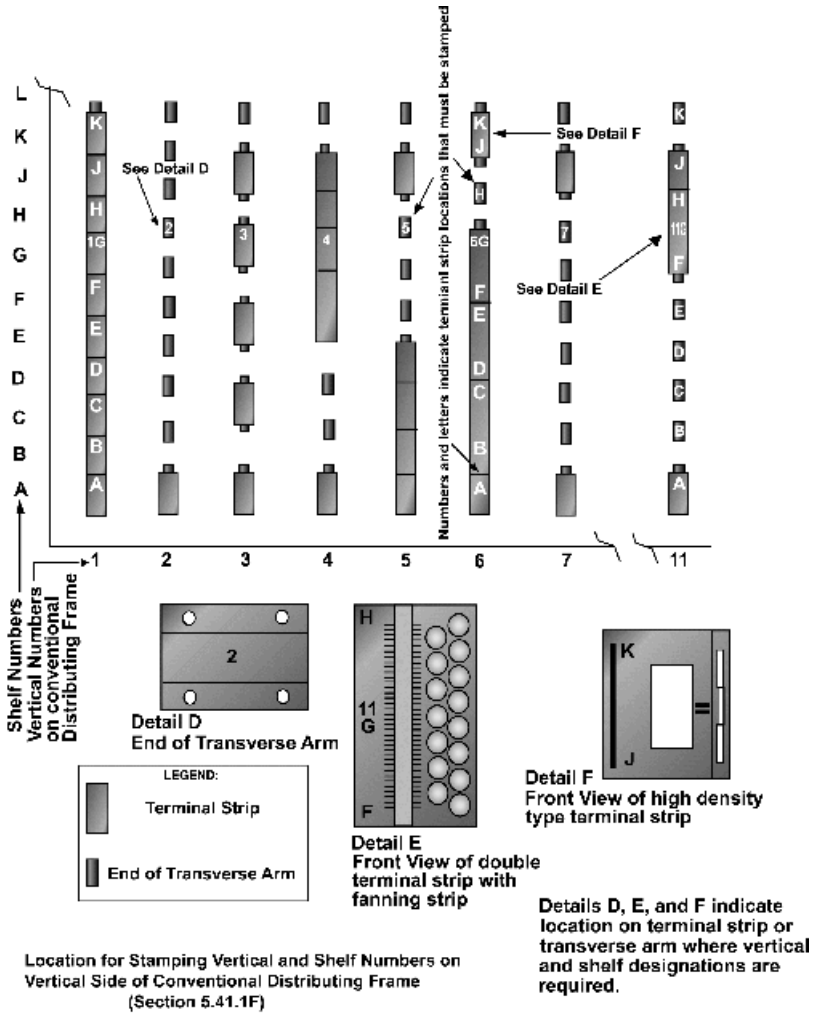


Figure 89.



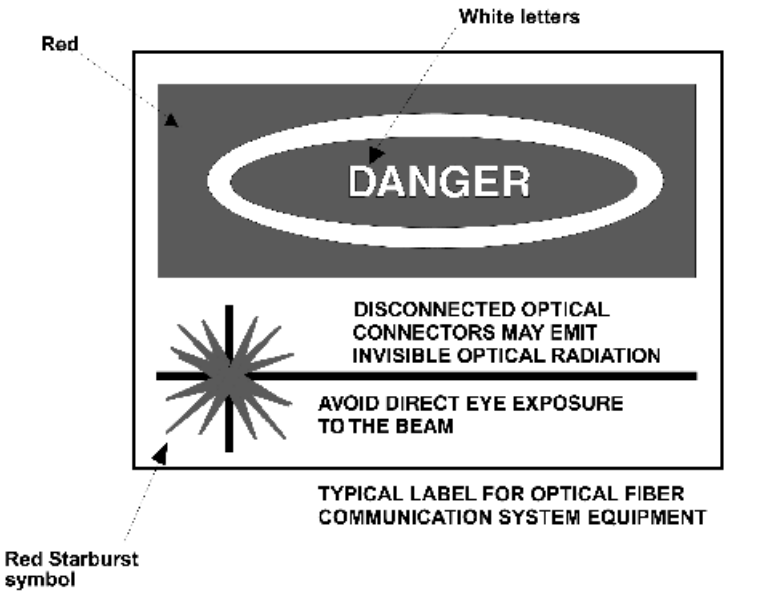
Location of Stamping for Vertical and Shelf Numbers on Horizontal Side of Conventional Distributing Frame
(Section 5.41.1F)

Figure 90.



Location for Stamping Vertical and Shelf Numbers on Vertical Side of Conventional Distributing Frame (Section 5.41.1F)

Figure 91.



TYPICAL LABEL FOR OPTICAL FIBER
COMMUNICATION SYSTEM PATCH ORDERS

Fiber Optic Warning Label
(Section 5.15.7)

Figure 92.

OFFICE: _____ TELCO ORD.# _____

CITY & STATE: _____ VENDOR ORD.# _____

VENDOR: _____

All OEM Equipment must be tested to determine if isolation from framework ground is required per vendor practices and the results should be entered below.

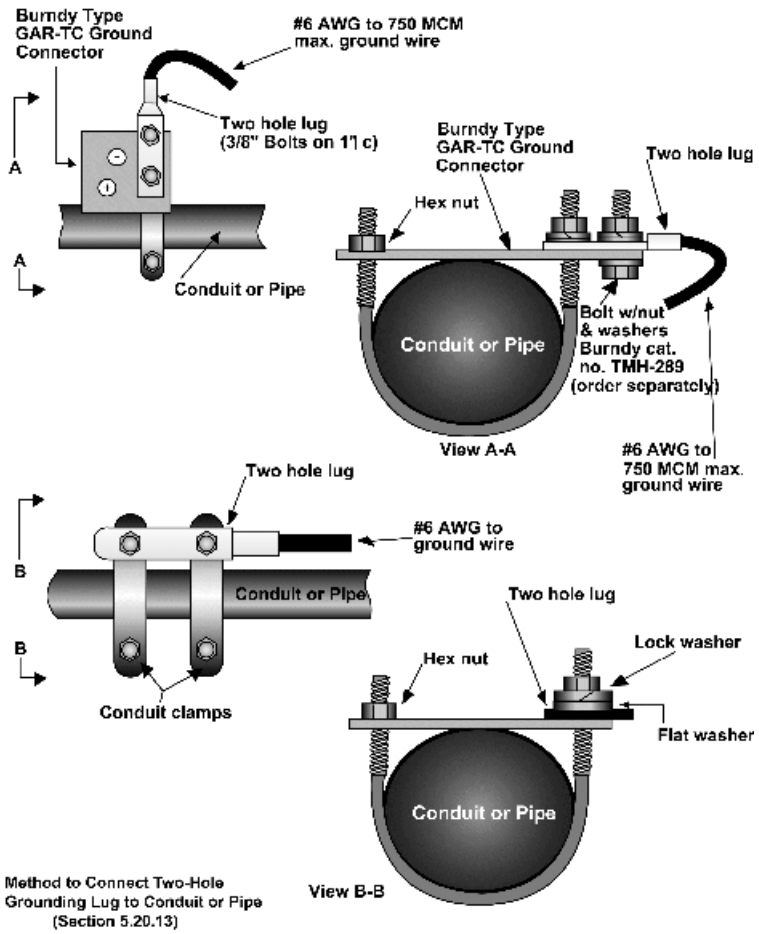
Equipment Type	Date Tested	Isolation req'd Yes	Isolation req'd No	Tested By:

Please forward completed form prior to job turnover to:

Jean Reimer
N17 W24300 Riverwood
Waukesha, WI 53188
(414) 523-1517

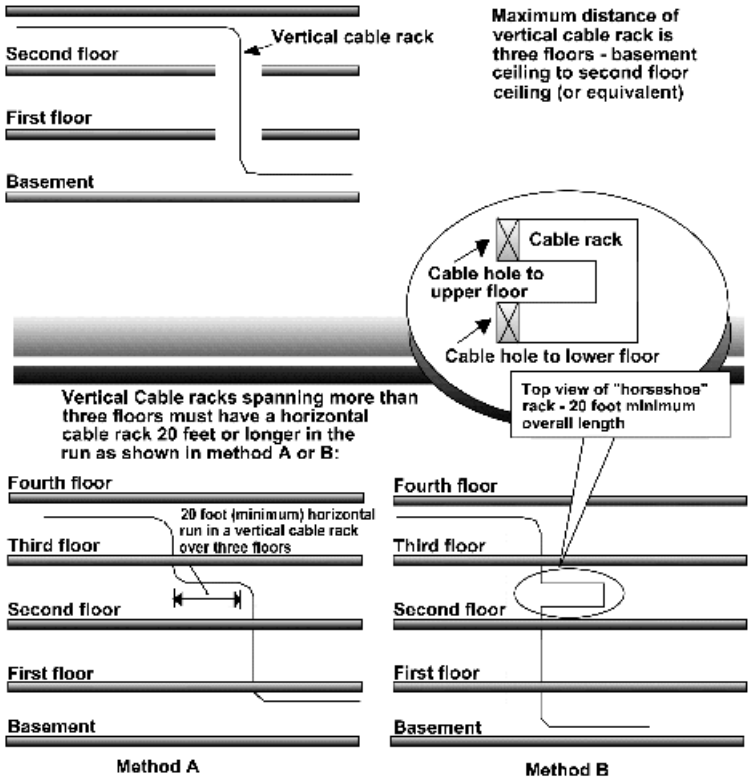
OEM Unit and Chassis Ground Test Form
(Section 5.20.17)

Figure 93.



Method to Connect Two-Hole Grounding Lug to Conduit or Pipe (Section 5.20.13)

Figure 94.



Vertical Power Cable Rack Configuration
(Section 5.17.8)

7. RADIO/TOWER INSTALLATION QUALITY AND GROUNDING

This Technical Reference is intended for all personnel installing radio equipment and towers/antennas in the Ameritech Region. The attached procedures must be adhered to and can only be changed or modified by an authorized Ameritech representative.

This document addresses the procedures to be utilized in installation and Bonding and Grounding of radio equipment and associated towers/antennas. It is an attempt to provide sufficient information for installing and grounding of radio sites and allow the design of an effective, reliable, economical installation of radio equipment.

CONTENTS

1. External Ring Ground

2. Internal Ring Ground Bus

3. Roof Mounted Ring Bus

4. General Radio/Microwave Grounding Requirements

5. Tower/Antenna Grounding

7.1. EXTERNAL RING GROUND

7.1.1.

The external ring ground system is used for radio and microwave stations equipped with antenna towers. In some locations a partial ring ground or individual driven rods may have to be used.

7.1.2.

The external ring ground system (bus) is composed of a #2 AWG solid tinned copper wire buried below the frost line or at least 30 inches below grade and spaced two (2) feet from building foundation and tower footings.

7.1.3.

Driven ground rods are 5/8-inch diameter, eight (8) feet long copper plated steel rods connected to the external ring bus at 10 to15 feet intervals.

7.1.4.

Below grade connections shall be exothermic welding process. Connections to above ground objects should be cadwelded, where practical, or with crimp type connections.

7.1.5.

The external ring bus shall be bonded to the tower ring bus using exothermic welding process.

7.1.6.

All metallic objects installed on the roof (for roof antennas) or outside of the building should be connected to exterior ring bus with a minimum #6 AWG copper wire.

7.1.7.

External ring bus should be bonded to:

A. The Office Principal Ground Point (OPGP) in two places

B. The Hatch Plate and/or Exterior Ground Bar

C. The Tower Ring Ground Bus in two places

7.2. INTERNAL RING GROUND BUS (PERIPHERAL BUS)

7.2.1.

The Peripheral Bus shall be for a "closed ground loop" above and around the radio equipment frames using a #2 AWG wire.

7.2.2.

The peripheral bus will be mounted on insulators and bonded to the Office Principal Ground Point or the nearest Central Office Ground Bar if the radio equipment is on a different floor. If the building is to be used for radio equipment only, bond the Interior Ring to the Exterior Ring ground at the four corners of the building.

7.2.3.

The hatch plate or exterior ground bar shall be grounded to the exterior ring ground bus using a #2 AWG wire.

7.2.4.

Metallic objects within six (6) feet of the radio equipment shall be bonded to the interior peripheral bus using a #6 AWG wire.

7.2.5.

Radio/Microwave equipment and cables shall **not** be routed within a minimum of three (3) feet of any Stored Program Control Switching (SPCS) system (i.e., ESS, DMS, EWSD, etc.) equipment.

7.3. ROOF MOUNTED ANTENNA RING BUS

7.3.1.

If a tower is roof mounted on a relay station or central office building, a ring shall be formed around the tower legs and bonded to the tower legs. This ring shall be bonded to the buried exterior ring bus system with a #2 AWG bare copper wire extending down the four corners of the building. On reinforced concrete buildings an additional conductor is required at the center

of each side. EXCEPTION: Reinforced concrete buildings having sides less than 100 feet in length are not required to have a down conductor at the center of each side.

7.3.2.

All metallic objects (i.e., air conditioning units, soil pipes, exhaust pipes, etc.) shall be bonded to the roof ring ground bus.

7.3.3.

Non-conductive fasteners shall be used for the down conductors to external ring ground.

7.4. GENERAL RADIO/MICROWAVE GENERAL GROUNDING REQUIREMENTS

7.4.1.

External ground bars shall be located near the coax/waveguide cable entrance and mounted on insulators.

7.4.2.

The exterior ground bar should be bonded to:

A. outer conductor of each coax/waveguide cable from the antenna/tower

B. hatch plate, if one exists

C. ice tray or shield

D. external ground

7.4.3.

Exothermic welding shall be used:

A. all below grade connections

B. copper and steel connections

C. stranded to solid connections

7.4.4.

All grounding conductors shall be run in the most direct practical manner without any sharp bends or changes in direction. When changes in direction are required, a minimum bending

radius of 12 inches shall be used. Wire/conductor connections shall be made toward the "Direction of Flow" to the ground reference.

7.5. TOWER/ANTENNA GROUNDING

7.5.1.

Coax cable outer conductors shall be bonded to the tower at the top, bottom and middle if the tower is over 100 feet in height.

7.5.2.

Aircraft warning light AC conduit should be bonded to the tower every 10 feet.

7.5.3.

Bond coax/waveguide to the tower ring ground bus prior to the horizontal bending (entering the building) with a #2 AWG wire.

7.5.4.

If the tower is guyed, the guy cables shall be grounded with a #2 AWG to ground rods at the anchor end.

7.5.5.

The ice tray/shield shall be bonded to the tower.

8. GLOSSARY

Armored Cable A fabricated cable assembly consisting of two or more insulated conductors in a flexible metallic enclosure (commonly called "BX").

Conduit A raceway of circular cross section through which conductors are installed. Conduit is used to protect the conductors running inside the core. The following types of conduit are in general use with telecommunications equipment: rigid metal conduit, electrical metallic tubing, flexible conduit, liquidtight flexible conduit.

Electrical Metallic Tubing A thin-walled metal raceway of circular cross section constructed for the purpose of protecting wires or cables (commonly called "thinwall").

Flexible Conduit A flexible raceway of circular cross section specially constructed of a helically wound metal strip with interlocking edges (commonly called "Greenfield").

Grounding Conductor A conductor used to connect equipment or the ground circuit of a wiring system to a grounding electrode. This conductor does not have a paired conductor for a return path. Grounding conductors are not ordinarily used to carry load currents under normal conditions. Grounding conductors include bonding conductors. The requirements for bonding conductors are the same as for grounding conductors except where differences are specifically noted.

Isolated Ground Plane A set of interconnected frames that is intentionally grounded by making only one connection to a given ground reference. This plane, taken as a conductive unit with all of its metallic surfaces and grounding wires bonded together, is insulated from contact with any other grounded metalwork in the building. The boundary of the isolated ground plane is at the MGB (main ground bus bar) of the ground window.

Liquidtight Flexible Metal Conduit A raceway of circular cross section having an outer liquidtight, non-metallic jacket over an inner flexible metal core.

Lockwasher A flat ring of metal used to distribute pressure from a nut or the head of a bolt. Accepted types are split ring and external tooth star washer.

Main Ground Bus The bus bar or bars that comprise the ground window interface between the isolated and integrated ground systems.

Metal-Clad Cable A factory assembled cable of one or more conductors, each individually insulated and enclosed in a metallic sheath of interlocking tape or a smooth corrugated tube.

Non-Metallic Coated Metal-Clad Cable A fabricated assembly consisting of two or more insulated conductors in an inner flexible metallic enclosure with a corrosion-resistant, non-metallic outer jacket (includes TECK 90 type cable).

Non-Metallic Sheathed Cable A fabricated assembly of insulated conductors having an outer sheath of moisture-resistant, flame retardant, non-metallic material (commonly called "Romex").

Palnut A second nut used on a bolt immediately after the first nut is installed. Palnuts are normally found on bus bar clamps as a locking device to prevent the loosening of the first nut.

Power Connection For the requirements of this document, power connections refer to all connections supplying DC power to equipment with a conductor sized at No. 14 AWG or larger and fused at over 5 amps.

Raceway Any channel for enclosing any loosely holding wires, cables, or bus bars in interior applications . Raceways may be of metal or insulating material, and the term includes rigid conduit, flexible conduit, electrical metallic tubing, wireways and busways.

Rigid Metal Conduit A heavy gauge aluminum or steel raceway of circular cross section of standard weight and thickness permitting the cutting of standard threads.

Switchboard Cable Metallic wire and cable used for communication transfer. Does not include power or fiber-optic cables. Does include communications cables, connectorized cables, coax cables, shielded cables, telephone cables, etc. Includes wire (P-wire, single, paired, etc.) that is approved for use on cable rack.

Tie Wrap A cable-tying system employing a single plastic strap that is wrapped around a cable bundle. The loose end of the tie wrap is fed into a grooved head which prevents the end of the tie wrap from coming free. Special tools are required to ensure the end of the tie wrap is cut off precisely flush or under flush with the head. Twist-tie wraps similar to those used with bread wrappers are not acceptable.

9. ACRONYMS

AC Alternating Current

ACEG	Alternating Current Equipment Ground
AOC	Ameritech Operating Company
APEX	Ameritech Publishing Express
AWG	American Wire Gauge
BDCBB	Battery Distribution Circuit Breaker Bay
BDFB	Battery Distribution Fuse Bay
CEFGB	Cable Entrance Facility Ground Bus
CEV	Controlled Equipment Vault
CLEI	Common Language Equipment Identification
CO	Central Office
COSMIC	Common System Main Inter-Connecting
DC	Direct Current
DCTU	Directly Connected Test Unit
DF	Distributing Frame
DSX	Digital Signal Cross-Connect
EMI	Electromagnetic Interference
EMT	Electrical Metallic Tubing
EQ	Earthquake
ESD	Electrostatic Discharge
FBE	Frame Bonding Equalizer
GEB	Grounding Electrode Bus

HEPA	High Efficiency Particle Arrestance
ICB	Integrated Collection Bus
INGSP	Integrated Ground Splice Plate
LBB	Logic Bus Bar
MCM	Circular Mills, Thousands
MDF	Main Distributing Frame
MGB	Main Ground Bus
MMSU	Modular Metallic Service Unit
MOP	Method Of Procedure
NEC	National Electrical Code
OEM	Original Equipment Manufacturer
OPGPB	Office Principal Ground Point Bus
OSHA	Occupational Safety and Health Administration
OTDR	Optical Time Domain Reflectormeter
PD	Power Distribution
PO	Purchase Order
RF	Radio Frequency
RR	Relay Rack
SPCS	Stored Program Control System
STP	Signal Transfer Point
TEO	Telephone Equipment Order
UL	Underwriter's Laboratory

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ATTACHMENT 1 - Attachment: 735A Coaxial Cable and BNC Installation Requirements

NOTE: The material in attachments 1, 2 and 3 of this document will be removed from the next issue. The materials covered will be reissued under a separate document number. For questions, please contact Sam Pullum on (312) 727–2285.

This technical document is intended for everyone installing DS-3 related coaxial cables and connectors for within Ameritech. The attached procedures must be adhered to and can only be changed or modified by an authorized Ameritech Transport Technical Support Engineer.

The document addresses the mini coaxial cable, such as Compscope's 5535 and AT&Ts 735A. The 735A/1 735A/5535 mini coaxial cables are utilized when the distance from the equipment to the DSX 3 is less than 220 feet. For distances longer than 220 feet, but less than 450 feet, 734D/5568S type cable should be used. The 734D/5568S type cables are addressed by another document.

1. COAXIAL CABLE TERMINATIONS

Investigation into DS3 problems, specifically intermittent outages, has shown that cable terminations are the number one problem.

Termination caused outages fall into three specific areas:

Connectors

The Bayonet Naval Connector (BNC) has a standard interface specification on the plug side of the connector. The cable termination to the connector is designed to mate with a specific type (size) of coaxial cable. Reports of the wrong type of connector installed on a coaxial cable have been found. The reports indicate that the cable shield was loose or the center pin contact did not seat properly, causing a poor connection and intermittent outages.

Terminating Procedures

This is the major area of concern as far as a cause of intermittent outages. Many of the BNCs that have been examined have had little or no solder on the center point to cable contact. Many other BNCs have had poorly soldered center pin coax contacts. Still other terminations had the coaxial cable improperly trimmed causing the center pin to be either recessed or extended too far from the front of the connector. The consequence is a poor connection with the mating connector and intermittent unexplained outages.

Misseated BNCs

BNCs not fully seated with the connector on the equipment. The BNC must be fully seated and the body of the connector rotated until the locking pins are seated in the grooves of the mating connector. Unless the BNC is fully locked into place, the center pin will not seat correctly thus causing a poor connection.

Poor termination of coaxial cable is not a new phenomenon but has been with us from the beginning. Using only Ameritech approved parts and procedures should eliminate the majority of outages caused by poor terminations.

2. REOUIRED PARTS

Coaxial Cable (Choose one type):

Compscope 5535 type cable or equivalent (first choice either six or twelve conductor type) meeting or exceeding (MIL-C-1 7D).

AT&T 1735A type (first choice either six or twelve conductor type) meeting or exceeding (MIL-C-17D).

AT&T 735A type or equivalent 735A, meeting or exceeding (MIL-C-17D).

NOTE: The 735A/5535 cable is to be used only when the distance from the equipment to the DSX3 bay is less than 220 ft.

BNC Straight Male Plug

Trompeter, part number UPL 220-026

AT&T Comcode 40613371

Right angle BNC Adapters

Radiall P/N R142770

Trumpeter P/N UADRNMF20

3 APPROVED TOOLS

Programmable Stripper, one required:

Schleuniger 207 programmable stripping machine or equivalent

Schleuniger 257 programmable stripping machine or equivalent

Mitutoyo 1411 gauge with BNC adapter or equivalent

Center Twelve Indent Pin Crimp Tool: Trompter 010- 0080. No substitutions are allowed:

Center Pin Go/No Go Gauge (required): Trompeter 010- 0101

Ferrule Crimp Tools

Trompeter CT3/CD3-1 1.

AT&T 5648D2 Outer Crimp Frame, COMCODE 407060235, with 5648D13 Die, 734f735 COM-CODE 407060284 or equivalent ferrule crimp tool AT&T 1047A / detail 2A with AT&T

A4081 / detail 7-03.

Coaxial Cable Cutter (one required)

Benner - Newman UP - 376 or equivalent

Excelta

4. RECOMMENDED TOOLS

1OX Magnifying glass or greater with light (one required): Luxo 1 FM-1 A 1530 or equivalent

Single use swab (isopropyl alcohol 70% or higher) (one required)

A. Becton - Dickson 6896 or equivalent

B. KENDALL R6818 Texswabs Crushtube swab P/N 726

The vendor, may also choose to use a work platform that is capable of being clamped to steps of an office ladder.

5. SPECIFICATIONS

Parts used by vendors in the assembly of a BNC shall meet the appropriate applicable standards for that part.

Applicable Documents:

- Military Specifications and Standards
- MIL-C-39012- General specification for Connectors and coaxial cable

- MIL-G-45204-Gold plating electrodeposited
- MIL-H-7199 Heat treatment of wrought BeCu alloys
- MIL-P-19468 Plastic rods, polytetraflourethylene, molded and extruded
- MIL-STD-202 Test methods for electronic and electrical component parts

Federal Specifications

- QQ-B-626 Brass
- QQ-B-750 Phosphor bronze
- QQ-C-530 Beryllium copper alloy
- QQ-N-290 Nickel plating, electrodeposited solder, tin alloy, lead-tin alloy and lead-tin alloy
- QQ-S-763 Stainless steel
- QQ-R-765 Silicone rubber
- QQ-S-365S Silver plate
- LP-390C Polyethylene
- WW-T-799 Copper
- FED-STD-H28 Screw thread standards for federal services

Coaxial Cable

Coaxial Cable shall meet UL standards for flame-ability UL 1666 and be rated CMR or better. Refer to TR-NMT-000063 for additional information. The fire rating shall be marked on the cable as per TR-TSY-000081.

Impedance: 75 ohms + or - 3 ohms at 50 MHz

Capacitance: 17.5 + or - 0.5 pf/foot nominal

Dielectric strength: 3500 volts RMS, minimum

Corona: 1500 volts RMS, minimum at 60 Hz

1	MHz:	04.9 dB
5	MHz:	10.5 dB
10	MHz:	14.6 dB
50	MHz:	32.7 dB
100	MHz:	36.5 dB
200	MHz:	66.4 dB

Attenuation: Nominal attenuation per 1,000 feet vs. frequency

The attenuation at 100 MHz shall not be more than 3.70 times the attenuation at 10 MHz.

Stripping force: To insure acceptable stripping and preparation of the cable by means of automated cuffing and striping machines, adhesion force between the outer jacket and shield for a 3.0 inch slug length shall be between 6 And 30 lbs. Adhesion force between dielectric and center wire for a 1.0 inch slug length shall be 5 lbs.

Cable bends: The cable shall be capable of meeting all the electrical requirements over the frequency range of 20 MHz to 200 MHz when subjected to bend radii as small as 1/4 inch radius.

Dimensional stability: Cable shall meet shrinkage and growth requirements in accordance with the following test: Starting at a 20°C ambient temperature, a 2.5, 5.0, 10.0 and 15.0 ft. section of cable shall be subjected to a temperature of 70°C for two hours. Then -20°C for 0.5 hours (transition rate not to exceed 6°C/min), for a total of four temperature cycles. After the four cycles the maximum dimensional change shall not exceed the following:

1. Dielectric: Protrusion beyond the center conductor shall not exceed .050 inch and/or shrink back from the center conductor shall not exceed .050 inch.

2. Outer jacket and braid: Protrusion and/or shrinkback shall not exceed . 100 inch in reference to the center conductor.

NOTE: Various data shall be taken on the samples. The data shall exhibit characteristics of a normal distribution. The mean of the data shall not be closer than four and 1/2 standard deviations to the above noted specification limits **(CPK = 1.50)**.

Shield type: 0.002 inch aluminum on a 0.001 inch polyester laminate.

Shield application: Longitudinal with aluminum side facing out.

Shield overlay: 3/32 inch minimum.

Shield splicing: No more than one splice per 1000 feet of cable. The overlap shall be 2 inches nominal.

Braid type: 38 AWG tinned, annealed copper braid.

Braid coverage: 90% to 95%.

Braid angle: Between 15 and 45 degrees.

Braid application: Directly over foil shield; consistent with commercial practice.

Diameter over braid: 0. 105 inches maximum.

Braid irregularities: There shall be no strands of wires that are not interwoven and there shall be no splice of complete braiding. In the event of a complete ribbon break, the wires shall not be missing for more than two turns of the braid. Exclusive of complete ribbon breaks, at any point along the cable, the allowable number of missing strands of wires shall not be more than three strands at any cross section. Prior to the application of the outer jacket unsecured ends of wires protruding from the outer braid shall be trimmed off close to the surface of the braid. Jacket type: Slate, flexible, low migrating polyvinyl chloride (PVC).

Jacket thickness: 0.010 inches nominal 0.008 inches minimum at any point.

Cable diameter: 0.122 inches nominal, 0.124 inches maximum.

Conductor continuity: There will be no splices, anywhere in the coaxial cable center conductor. The center conductor shall electrically be one continuous length. Similarly, the braid in every length shall be in one continuous length. DC voltage not to exceed 40 volts.

Conductor resistance: The maximum DC resistance of the center conductor shall be 45 ohms per 1000 feet.

Insulation resistance: 6,000,000 megohms - feet between inner and outer conductor, as measured at 68 degrees Fahrenheit.

Relative dielectric constant: 1.60 nominal.

Jacket spark test: 100% of completed cable shall withstand, without breakdown, a potential applied between the outer conductor and the cable jacket. Test method is to apply a DC test voltage of 3,000 volts AC RMS or 4,200 volts DC.

Return loss: 100% of completed cable shall have a return loss of 30 db minimum (worst single value) in the frequency range of 15 to 90 MHz when cable is terminated in 75 ohms on a cali-

brated SRL bridge. For lengths greater than 700 feet, measure from both ends. For shorter lengths, measure from one end only.

BNC Electrical

Impedance: 75 ohms nominal

Dielectric withstanding voltage: There shall be no evidence of breakdown, corona or flash over when the unit is tested in accordance with MIL-STD-202, method 301. The following details shall apply:

A. Test voltage: 1500 V AC RMS, at 60 Hz at 25°C plus or minus 5°C, 55% plus or minus 15% R.H. at sea level.

B. Method of mounting: Securely mated to its appropriated mating connector and assembled to its appropriate cable, where applicable.

C. Point of application: Between the center and outer contacts.

Voltage rating: 500 VAC, peak

VSMR: 1:15 (return loss better than 23.0 db)

RF leakage: -55db at 2 GHz

Frequency range: DC to 4 GHz

Practical frequency range: DC to 2 GHz

Contact resistance: A current of 15 milli-amps shall be passed through the contacts with no more than 100 milli-volts open circuit per MIL-STD-202, method 307. The contact resistance shall not exceed the maximum limits as specified.

A. Center contact Initial: 6.0 milli-ohms max. Final (after environmental and durability tests): 8.0 milli-ohms max.

B. Outer contact Initial 1.0 milli-ohms max. Final (after environmental and durability tests): 2.0 milli-ohms max.

Test current: 20 ma max.

Insulation resistance: 5000 megohms minimum, between the center and outer contacts.

Insertion loss: 0.3 db max. at 2 GHz

Design and construction: The design, construction and physical dimensions shall be in accordance with the applicable drawing. Dimensions are in inches unless otherwise noted.

A. Interface dimensions shall be in accordance with applicable figures.

Center contact: Gold plating must meet the requirements of Bellcore specification TR-TSY-000078. Contact mating surfaces must be gold plated with a thickness of 50 micro-inches.

Crimp ferrule and cover plate: Bright nickel plate of a ductile nickel alloy, not susceptible to cracking or flaking under crimping stresses, or bright tin plate to a min. thickness of 100 micro-inches.

Materials: Unless otherwise specified, materials and markings shall withstand solvents when tested in accordance with MIL-STD-202.

Durability: Connectors shall withstand 500 cycles of engagement and disengagement. After 500 cycles, the mated assemblies shall meet the initial requirements. Center contact retention forces: All center contacts shall be captured in both directions and capable of withstanding the forces specified.

A. 2 lbs. min. axial force toward the back of the connector.

B. 6 lbs. min. axial force toward the face of the connector.

C. 4 ounce inch minimum rotation force.

Coaxial cable center conductor constraints: The connector must be designed to constrain a continual force of 5 lbs. Minimum applied by the cable center conductor along its longitudinal axis. Such constraints must:

A. Hold the geometry of the connector interface within specification parameters.

B. Prevent the center conductor from shorting to the connector body.

C. Insure the electrical integrity of the connector.

Solder weep hole: The center contact shall have a drilled hole or milled solder slot, which exposes the inner diameter of the wire entry clearance hole. The hole shall be clearly visible and unobstructed to facilitate inspection of crimp joint between contact and wire.

Thermal shock: The BNC shall show no sign of cracking, delamination of finishes or any other damage which in any way impairs electrical or mechanical performance when subjected to testing in accordance with MIL-STD-202, method 107. The following details apply:

A. Method of mounting: Mated condition - connector shall be assembled to its appropriate cable and shall be mated securely to its appropriate mating connector.

B. Test condition: Test condition A, except step three shall be +125 degrees Celsius.

Steady state humidity: The unit shall withstand testing in accordance with MIL-STD-202, method 103, test condition B. The following details and exceptions shall apply:

A. Method of mounting mated condition: Connector shall be assembled to its appropriate cable and shall be mated securely to its appropriate mating connector.

B. There shall be no polarizing voltages applied.

C. After completion of test, each unit shall meet 1000 megohms minimum insulation resistance and the dielectric strength specified.

Salt spray: Units shall exhibit no corrosion, detrimental to the electrical or mechanical performance, when tested in accordance with MIL-STD-202, method 101. The following details shall apply.

A. Method of mounting: Mated condition - connector shall be assembled to its appropriate cable and shall be mated securely to its appropriate mating connector.

B. Test condition: Salt solution 5% salt concentration.

Vibration: The unit shall show no signs of discontinuity during vibration or cracking, chipping, loosening of parts, or any other damage which in any way impairs the electrical or mechanical performance when subjected to testing in accordance with MIL-STD-202, method 204. The following exceptions shall apply:

A. Method of mounting and measurement during vibration: Mated condition-connector shall be assembled to its appropriate cable and shall be mated securely to its appropriate mating connector, in accordance with MIL-C-39012 paragraph 4.6.15.2. Test condition A.

B. Exceptions:

1. A movement of .06 inch double amplitude or IOGs peak, which ever is less.

2. The frequency range and sweep shall be 10 to 500 Hz and return to 10 Hz in 15 minutes.

C. Four sweeps in each of the three axis.

D. Monitoring during vibration for any signs of discontinuity through each conductor and contact in accordance with MIL-C-39012, paragraph 4.6.15.

Shock: The unit shall show no signs of cracking, chipping, loosening of parts or any other damage which in any way impair the electrical or mechanical performance when subjected to testing in accordance with MIL-STD-202, method 213. The following details and exceptions shall apply:

A. Method of mounting: mated condition - connector shall be assembled to its appropriate cable and shall be mated securely to its appropriate mating connector.

B. Test conditions:

1. Exception

2. A peak value of 50 Gs at a 11 millisecond duration.

3. Three impacts in each direction of three mutually perpendicular planes.

Any changes in design of or the materials affecting form, fit or function of the part described herein must be approved by Ameritech prior to incorporation by the vendor.

Coaxial cable dimensional stability: Coaxial cable/connector assemblies will fail when the force produced by the shrinkage or growth of the cable plastic material during heat cycling exceeds the connector constraint design of +6 or -2 lbs. Such shrinkage or growth will cause the cable center wire to protrude or retract within the cavity of the connector with sufficient force to fracture solder joints and push out improperly retained center contacts of BNC. It should also be noted that cable shrinkage or growth, regardless of cable length, must be less than .050 inches on each end of the cable when tested according to MIL-C-1 7 (this is substantially less than MIL-C-17 allows). The .050 inch allowance insures that the growth or shrinkage forces will not exceed the +6 or -2 lbs. design constraint of the connector. The center pin crimp strength must be at least 6.5 pounds.

6. COAX STRIPPING

The programming instructions for the Schleuniger stripping tools are detailed in the 207's operating manual. Stripping of coax cable must be done only on an automatic stripping machine.

Installers shall not hand strip coaxial cables.

The vendors shall be certified, to assemble BNCs by Ameritech Technical Support Transport Quality Engineer. The certification process will require the vendor to demonstrate the ability to meet Ameritech's requirements and the national standards of the BNC assembly. Vendor's installers shall be certified, by the vendor and Ameritech, in coaxial cable stripping, soldering and

BNC assembly. No installations will take place before certification approval has been received. Ameritech employees also require certification if they are installing connectors on coaxial cable for DS3 or higher service rates. The Telephone Learning Center provides a class for Ameritech Employees.

Vendor are required to provide, in writing to Ameritech's Transport Technical Support Quality Engineer, their installation and assembly procedures for installing BNCs, if they differ from the Ameritech procedures. Also to be included in the written information should be the type of coax and BNC to be used If they are to be made by the vendor in coaxial cable and/or BNC, the vendor is be required to make written notification to:

Technical Support Transport Quality Engineer

Ameritech

225 W. Randolph 24C

Chicago, IL 60606

This notification must be made in advance, and the vendor must have written acceptance from the Transport Quality Engineer before using a different connector.

This notification must be made in advance, and the vendor must have written acceptance from the Transport Quality Engineer before using a different connector or assembly procedure.

The coax should be cleaved evenly at a 90 degree angle from the length using a coaxial cable cutter.

Example: Coaxial cable stripping dimensions, using 735A coaxial cable and a Trompeter BNC part number UPL 220-026.

Step	Length	Diameter
1	344	.105
2	438	.084
3	594	.018

After the correct length and settings have been documented by the vendor, the vendor shall inform Ameritech of their correct settings and assembly process in writing. For the approved connectors, the length settings should not change. Care must be taken to insure that the proper settings are used. If length settings are to be changed from the vendor's original approved setting the vendor must submit the new length setting and the reason for the change to the Ameritech Transport Technical Support QUALITY ENGINEER, in writing for approval, before

using the new settings. The diameter setting may vary by plus or minus 0.003" due to the variance in the coaxial cable. A good strip shall be a square clean cut. If the cut is not clean (has not cut through the braid or has cut beyond the surface of the dielectric) readjust the diameter setting until the strip is clean and the stripping dimension matches the template. Using the magnifying glass, the vendor will visually inspect the trimmed coax cable. The center conductor will not display any nicks.

If the exposed portion of the center conductor is bent at any time during the BNC installation operation, that portion of the bent center conductor must be cut off and the cable re-stripped.

The stripper should not have to be readjusted while making duplicate cable terminations on cable from the same reel of coax.

7. CRIMPING

The vendor is responsible for supplying a proper connection that exceeds industry standards and warranting the work against failures. Clean the exposed portion of the center conductor of the coax with a disposal alcohol pad/swab. If the center conductor is touched before the crimping operation is completed, the center conductor must be re-cleaned.

Place the pin fully on the center connector.

Using the approved tool, crimp the center pin to the center conductor.

The crimp must have eight indentations, spaced two indentations every 45 degrees.

The crimp must be able to meet a center pin pull test of 6.5 pounds. This test is destructive. Should this test be performed in the field, the pin that was tested must be cut off, the cable re-stripped and a new pin terminated on the cable.

8. ASSEMBLY

Slip the ferrule onto cable.

Slightly flare the braid by gently twisting the braid, and place the aluminum shield under the support sleeve, with the braid over the support sleeve. The braid should extend to the body of the connector. When the connector is finished, the braid should not extend beyond the crimped ferrule. DO NOT FOLD THE BRAID BACK.

Place the gauge on the connector and adjust the body so that the gauge is rating a pin height of zero (+ or - 10 mills).The needle shall go around the face of the gauge only once.

NOTE: The setting of the revolution counting dial on the gauge, should be at one. If it is not at one, the length is not correct even though the needle is within the tolerances.

Slip the ferrule down to the body of the BNC. With the gauge still reading a pin height as close to 0 as possible and using the proper crimp tool, crimp the ferrule where the ferrule and body of the BNC meet.

The ferrule must be buffed against the connector body, be single crimped, and should exhibit six flat surfaces with no fins or excessive rounding at the sixty degree comers (note: see exception below). The braided shield should not extend beyond the point were the ferrule and body meet.

Exception: one side of the ferrule will have an IDENTIFIABLE MARK that shall be different for each vendor. Example: NTI for Northern Telecom, ACT for Alcatel, AT&T for AT&T and ADC for ADC, etc. The identifiable marking could also be a part number, but only if no other vendor or Ameritech technician has access to a connector with that part number. If the vendor uses a part number as the identifying mark, the part number must be sent to the Ameritech Transmission Support Transport Quality Engineer. The part must be one of the Ameritech approved products.

If the crimp does not exhibit these qualities, the crimp must be redone, using a new ferrule and body.

Once a connector body has been locked on a center pin and removed the body must not be re-used. It must be replaced with a new connector body.

The pin height must now read between +20 mils to a -20 mils with the revolution dial showing one revolution. If the center pin height is outside of these limits the connector has failed and must be remade. The coaxial cable should be straight when making this measurement. For more information on Pin Height Measurement see Ameritech Technical Bulletin on BNC Acceptance Testing.

The standard BNC details are shown in Figure 1 and 3. If the BNC now meets all requirements and passes all continuity and resistance tests, it may now be locked into place. The BNC must be fully seated and have both locating pins seated in the openings for them in the body of the BNC. The coaxial cable should be straight for two inches from the connector before starting any bends. Following the steps listed above does not relieve the vendor from meeting the national standards on BNCs. The finished product must mate properly and supply a good connection.

The vendors must not install coaxial cable in a manner that results in excess slack. Excess slack is not to be stored on Ameritech cable racks.

The outside cable sheath of 1735A will be stripped on the vertical portion of the bay, allowing 735A cable to be routed to the proper shelves, following generally accepted cabling techniques.

There will be no coaxial cable splices installed anywhere in a coaxial cable used for DS3 or higher rated service. Any questions on Ameritech 735A type cable and BNC assembly may be referred to the Ameritech Technical Support Transport Quality Engineer.

Questions regarding this document should be directed to the Ameritech Transport Technical Support Members list below:

Byron Atkinson (312) 727-2662

Sam Pullum (312) 727-2285

Any variations of BNC assembly for 735A,1735A, or 5535 type cable must be sent to Ameritech in writing and approved before the vendor starts any coaxial cable assembly using the modification. Send any requests for assembly variations to:

Technical Support Transport Quality Engineer

Ameritech

225 W. Randolph 24C

Chicago, IL 60606

ATTACHMENT 2 - Attachment: 734D Coaxial Cable and BNC Installation Requirements

NOTE: The material in attachments 1, 2 and 3 of this document will be removed from the next issue. The materials covered will be reissued under a separate document number. For questions, please contact Sam Pullum on (312) 727–2285.

This document is to inform all personnel installing DS3 cabling and connectors of Ameritech's minimum requirements for material and tools used in assembly of 5568S/734D type coaxial cable and connectors carrying transmission rates of DS3 or higher.

The 5568S/734D is a new cable type that is a direct replacement for 734A type cable, and should be used when the distances from the equipment to the DSX3 are over 200 feet, but less than 450 feet. Although 5568S/734D cable can be used for distances less than 200 feet, 735/1735A/5535 type coaxial cable will normally be utilized for distances of less than 220 feet. The 735/1735A/5535 cables are covered under a separate document.

After July 30,1994, 5568S/734D type coaxial cable must be used instead of **734A** type cable. After July 30, 734A type cable should no longer be used. The 734A type cable is not compatible with center pin crimping.

1. COAXIAL CABLE TERMINATIONS

Investigation into DS3 problems, specifically intermittent outages has shown that cable terminations are the number one problem. Termination caused outages fall into three specific areas:

Connectors

The Bayonet Naval Connector (BNC) has a standard interface specification on the plug side of the connector, additionally the cable termination to the connector is designed to mate with a specific type (size) of coaxial cable. Reports of the wrong connector installed on the coax cable have been noted. The reports indicate that the cable shield was loose or the center pin contact did not seat properly, causing a poor connection and intermittent outages.

Terminating Procedures

This is the major area of concern as far as a cause of intermittent outages. Many of the BNCs that have been examined have had little or no crimp on the center point to cable contact. Many other BNCs have had poorly crimped center pin coax contacts. Still other terminations had the coaxial cable improperly trimmed, causing the center pin to be either recessed or extended too far from the front of the connector, resulting in a poor connection with the mating connector and often intermittent outages.

Misseated BNCs

BNCs not fully seated with the connector on the equipment. The BNC must be fully seated and the body of the connector rotated until the locking pins are seated in the grooves of the mating connector. Unless the BNC is fully locked into place, the center pin will not seat correctly, thus causing a poor connection.

Poor termination of coaxial cable is not a new phenomenon but has been with us from the beginning. Using only Ameritech approved parts and procedures should eliminate the majority of outages caused by poor terminations.

All vendors, BNC procedures must be certified by Network Technical Support Transport. The vendor will in turn certify their own installers before allowing them to work on any Ameritech connectors. The vendors certification may be revoked any time that the connectors installed by them fail to meet the Ameritech and industry standards.

All personnel (both vendors and Ameritech technicians/installers) installing BNCs for Ameritech DS3s must be certified as being trained and knowledgeable in the proper assembly steps and testing procedures.

2 . APPROVED PARTS

Coaxial Cable

A. AT&T 734D

B. Comscope 5568S or equivalent cable

BNC Male Plug

For use with 734D/5568S type coaxial cable:

A. Trumpeter Straight Male part number UPL 220-025

B. Straight Male AT&T Comcode 405784273 KS-23558 list 5

C. Straight Male AT&T Comcode 405974007 with AT&T Markings

Right angle Adapters

A. Radiall P/N R142770

B. Trumpeter P/N UADRNMF20

3 . APPROVED TOOLS

Programmable stripper, one required:

A. Schleuniger 207 programmable stripping machine or equivalent

B. Schleuniger 257 programmable stripping machine or equivalent

Mitutoyo 1411 gauge with BNC adapter or equivalent

Center twelve indent Pin Crimp Tool: Trompeter 010- 0080. No substitutions are allowed:

Center Pin Go/No Go Gauge (required): Trompeter 010-0101

Ferrule Crimp Tools

A. Trompeter P/N CT3-CD3-11 for use with 734D/5568S type cables (0.255 hex die)

B. AT&T 5648D2 Outer Crimp Frame, COMCODE 407060235, with 5648DI3 Die, 7341735 COMCODE 407060284 or equivalent ferrule crimp tool

4. RECOMMENDED TOOLS

1OX Magnifying Glass with Light

A. Luxo 1 FM-1 A 1530 or equivalent

B. AT&T R4433

Single Use Swab (Isopropyl Alcohol 70%)

A. Becton - Dickson 6896 or equivalent

B. KENDALL R6818

The vendor, may choose to use a work platform that is capable of being clamped to steps of a central office ladder.

5 . SPECIFICATIONS

Parts used by vendors in the assembly of BNC shall meet the appropriate applicable standards for that part.

Applicable Documents

A. Military specifications and standards:

MIL-C-39012 General specification for Connectors, coaxial,

MIL-G-45204 Gold plating electrode posited,

MIL-H-7199 Heat treatment of wrought BeCu alloys

MIL-F-14256 Flux, crimping liquid (resin base)

MIL-P-19468 Plastic rods, polytetraflourethylene, molded and extruded.

MIL-STD-202 Test methods for electronic and electrical component parts.

B. Federal specifications:

QQ-B-626 Brass

QQ-B-75 Phosphor bronze

QQ-C-53 Beryllium copper alloy

QQ-N-29 Nickel plating, electrode posited

QQ-S-763 Stainless steel

QQ-13-765 Silicone rubber

QQ-S-365S Silver plate

ThP-390C Polyethylene

WW-T-799 Copper

FED-STD-H28 Screw thread standards for federal services

Coaxial Cable: Shall meet UL standards for flammability UL 83, ASTM B-50-69

Impedance: 75 ohms + or - 2 ohms

Capacitance 17pf/foot nominal

DC Resistance (ohms/1 000 ft) 11.0

Dielectric Strength 3500 volts RMS, minimum

Corona 1500 volts RMS, minimum

Attenuation

Db/1000 ft maximum at	1 MHz	2.5
Db/1000 ft maximum at	5 MHz	5.1
DB/1000 ft maximum at	10 MHz	7.2
DB/1000 ft maximum at	40 MHz	15.2
DB/1000 ft maximum at	50 MHz	16.7
DB/1000 ft maximum at	100 MHz	25.6
DB/1000 ft maximum at	200 MHz	36.6

Velocity of Propagation: 80.0% nominal.

Stripping force: To insure acceptable stripping and preparation of the cable by means of automated cutting and stripping machines, adhesion force between the outer jacket and shield for a 3.0 inch slug length shall be between 6 and 30 lbs. Adhesion force between dielectric and center wire for a 3.0 inch slug length shall be between 6 and 30 lbs.

Dimensional stability: Coaxial cable/connectors assemblies may fail when the force produced by the shrinkage or growth of the cable plastic material during heat cycling exceeds the connector constraint design of +6 or -2 lbs. Such shrinkage or growth will cause the cable center wire to protrude or retract Within the cavity of the connector with sufficient force to fracture crimp joints and push out improperly retained center contacts of BNC.

Cable shall meet shrinkage and growth requirements in accordance with the following test: starting at ambient temperature, a 2.5, 5.0, 10.0 and 15.0 ft section of cable shall be subjected to a temperature of 70°C for two hours. Then -20°C for 0.5 hours (transition rate not to exceed 6°C/min), for a total of four temperature cycles. After the four cycles the maximum dimensional change shall not exceed the following:

A. Dielectric: Protrusion beyond the center conductor shall not exceed .050 inch or shrink back from the center conductor shall not exceed .124 inch.

B. Outer jacket and braid: protrusion or shrink-back shall not exceed. 100 inch in reference to the center conductor.

NOTE: Variables data shall be taken on the samples. The data shall exhibit characteristics of a normal distribution. The mean of the data shall not be closer than four and 1/2 standard deviations to the above noted specification limits (CPK = 1.50).

It should also be noted that cable shrinkage or growth regardless of the cable length must be less than 050 inches on each end of the cable when tested according to MIL-C-17 (this is substantially less than MIL-C-17 allows). The .050 inch allowance insures that the growth or shrinkage forces will not exceed the +6 or - 2 lbs. design constraint of the connector.

Center Conductor 20AWG silver plated over copper.

Conductor Continuity There will be no splices, anywhere in the coaxial cable center conductor. The center conductor shall electrically be one continuous length. Similarly, the braid in every length shall be in one continuous length. DC voltage not to exceed 40 volts.

Dielectric Foam Polyethylene 404. DIA 1.60.

Shield 0.002 inch aluminum on a 0.001 inch polyester laminate.

Shield Application Longitudinal with aluminum side facing out.

Shield Overlap 3/32 inch minimum.

Shield Splicing No more than one splice per 1000 feet of cable. The overlap shall be 2 inches nominal.

Braid Type 38 AWG tinned, annealed copper braid.

Braid Coverage 90% to 95%.

Braid Angle Between 15 and 45 degrees.

Braid Application Directly over foil shield; consistent with commercial practice.

Diameter Over Braid 0. 105 inches maximum.

Braid Irregularities There shall be no strands of wires that are not interwoven and there shall be no splice of complete braiding. In the event of a complete ribbon break, the wires shall not be missing for more than two turns of the braid. Exclusive of com-

plete ribbon breaks, at any point along the cable, the allowable number of missing strands of wires shall not be more than three strands at any cross section. Prior to the application of the outer jacket unsecured ends of wires protruding from the outer braid shall be trimmed off close to the surface of the braid.

Jacket DIA over jacket: 0.235 +/- 0.008.

Jacket Type Slate, flexible, low migrating polyvinyl chloride (PVC).

Jacket Thickness 0.018 inches nominal 0.014 inches minimum at any point.

Insulation Resistance 6,000,000 megohms - feet between inner and outer conductor, as measured at 68 degrees Fahrenheit.

Relative Dielectric Constant 1.60 nominal.

Jacket Spark Test 100% of completed cable shall withstand, without breakdown, a potential applied between the outer conductor and the cable jacket. Test method is to apply a DC test voltage of 3,000 volts AC RMS or 4,200 volts DC.

Return Loss 100% of completed cable shall have a return loss of 30 dB minimum (worst single value) in the frequency range of 15 to 90 MHz when cable is terminated in 75 ohms on a calibrated SRL bridge. For lengths greater than 700 feet, measure from both ends. For shorter lengths, measure from one end only.

BNC Electrical

Impedance: 75 ohms nominal

Dielectric Withstanding Voltage: There shall be no evidence of breakdown, corona or flashover when the unit is tested in accordance with MIL-STD-202, method 301. The following details shall apply:

A. Test voltage: 1500 VAC RMS, at 60 Hz at 25C = or - 5C, 55% + or - 15% R.H. at sea level.

B. Method of mounting: Securely mated to its appropriated mating connector and assembled to its appropriate cable, where applicable.

C. Point of application: Between the center and outer contacts.

Voltage Rating 500 VAC, peak

VSMR 1: 15 (return loss better than 23.0 dB)

RF Leakage -55Db at 2 GHz

Frequency Range: DC to 4 GHz

Practical Frequency Range DC to 2 GHz

Contact Resistance Current of 15 milli-amps shall be passed through the contacts with no more than 100 millivolts open circuit per MIL-STD-202, method 307. The contact resistance shall not exceed the maximum limits as specified.

A. Center contact: Initial: 6.0 milli-ohms max. Final (after environmental and durability tests): 8.0 milli-ohms max.

B. Outer contact: Initial 1.0 milli-ohms max. Final (after environmental and durability tests): 2.0 milli-ohms max.

Test Current 20 ma max.

Insulation Resistance 5000 megohms min., between the center and outer contacts.

Design and Construction The design, construction and physical dimensions shall be in accordance with the applicable drawing. Dimensions are in inches unless otherwise noted.

A. Interface dimensions shall be in accordance with applicable figures.

Center Contact Gold plating must meet the requirements of Bellcore specification TR-TSY-0000778 Contact mating surfaces must be gold plated with a thickness of 50 micro-inches.

Crimp Ferrule and Cover Plate Bright nickel plate of a ductile nickel alloy not susceptible to cracking or flaking under crimping stresses, or bright tin plate to a min. thickness of 100 micro-inches.

Materials Unless otherwise specified, materials and markings shall withstand solvents when, tested in accordance with MIL-STD-202.

Durability Connectors shall withstand 500 cycles of engagement and disengagement. After 500 cycles the mated assemblies shall meet the initial requirements.

Center Contact Retention Forces AJI center contacts shall be captivated in both directions and capable of withstanding the forces specified.

A. 2 lbs. min. axial force toward the back of the connector.

B. 6 lbs. min. axial force toward the face of the connector.

C. 4 inch ounce min. rotation force.

Coaxial Cable Center Wire Constraints The connector must be designed to constrain a continual force of 6 lbs. minimum applied by the cable center wire along its longitudinal axis. Such constraints must:

A. Hold the geometry of the connector interface within specification parameters.

B. Prevent the center wire from shorting to the connector body.

C. Insure the electrical integrity of the connector.

Solder Weep Hole

The center contact shall have a drilled hole or milled solder slot, which exposes the inner diameter of the wire entry clearance hole. The hole shall be clearly visible and unobstructed to facilitate proper inspection of joint between contact and wire.

Thermal Shock

The BNC shall show no signs of cracking, denomination of finishes or any other damage which in any way impairs electrical or mechanical performance when subjected to testing in accordance with MIL-STD-202, method 107. The following details apply:

Method of mounting: Mated condition - connector shall be assembled to its appropriate cable and shall be mated securely to its appropriate mating connector.

Test condition: A, except step three shall be +125 degrees Celsius.

Steady State Humidity

The unit shall withstand testing in accordance with MIL-STD-202, method 103, test condition B. The following details and exceptions shall apply:

A. Method of mounting: Mated condition - connector shall be assembled to its appropriate cable and shall be mated securely to its appropriate mating connector.

B. There shall be no polarizing voltages applied.

C. After completion of test, each unit shall meet 1000 megohms minimum insulation resistance and the dielectric strength test specified.

Salt Spray

Units shall exhibit on corrosion detrimental to the electrical or mechanical performance when tested in accordance with the MIL-STD-202, method 101. The following details shall apply:

A. Method of mounting: Mated condition - connector shall be assembled to its appropriate cable and shall be mated securely to its appropriate mating connector.

B. Test condition

C. Salt solution 5% salt concentration.

Vibration

The unit shall show no signs of discontinuity during vibration or cracking, chipping, loosening of parts, or any other damage which in any way impairs the electrical or mechanical performance when subjected to testing in accordance with MIL-STD-202, method. The following exceptions shall apply:

A. Method of mounting and measurement during vibration: Mated condition -connector shall be assembled to its appropriate cable and shall be mated securely to its appropriate mating connector, in accordance with MIL-C-39012 paragraph 4.6.15.

B. Test condition: A.

C. Exceptions:

1. An input of .06 inch double amplitude or 10 G peak, whichever is less.

2. The frequency range and sweep shall be 10 to 500 Hz and return to 10 Hz in 15 minutes.

3. Four sweeps in each of the three axis.

4. Monitoring during vibration for any signs of discontinuity through each conductor and contact in accordance with MIL-C-39012, paragraph 4.6.15.

Shock

The unit shall show no signs of cracking, chipping, loosening of parts or any other damage which in any way impairs the electrical or mechanical performance when subjected to testing in accordance with MIL-STD-202, method 213. The following details and exceptions shall apply:

A. Method of mounting: Mated condition - connector shall be assembled to its appropriate cable and shall be mated securely to its appropriate mating connector.

B. Condition: A.

C. Exceptions:

1. Peak value of 50 Gs at 11 millisecond duration.

2. Three impacts in each direction of three mutually perpendicular planes.

Any changes in design of or the materials affecting form, fit or function of the part described herein must be approved by Ameritech prior to incorporation by the vendor.

6 . COAX STRIPPING

The programming instructions for the Schleuniger 207 stripping tool are detailed in the 207s operating manual. Stripping of coax cable must be done only on an automatic stripping machine.

Installers shall not hand strip coaxial cables. All personnel who are installing BNCs; shall be certified in coaxial cable stripping, crimping and BNC assembly. Vendor required to provide in writing to Ameritech their installation and assembly procedures for installing BNC if they differ from Ameritech's.

If any changes are to be made by the vendor in coaxial cable or BNC, the vendor shall be required to make written notification to:

Transport Technical Support Quality Engineer

Ameritech

225 W. Randolph 24C

Chicago, IL 60606

An example of coaxial cable stripping dimensions, using 734D coaxial cable, a Trumpeter BNC part number 220-025 and a Schleuniger 207 (old version):

Step	Length	Diameter
1	.344"	.185"
2	.438"	.135"
3	.5941"	.0340"

Once approved, the length settings shall not change-for the approved parts. Care must be taken to insure that the proper settings are used for each coaxial cable made.

If length settings are to be changed from the vendors original approved setting the vendor must submit the new length setting and the reason for the change to Ameritech in writing for approval, before using the new settings. The diameter setting may vary a plus or minus 0.003” due to the variance in the coaxial cable.

Using the magnifying glass, the vendor will visually inspect the trimmed coax cable. The center conductor will not display any nicks. If the cut is not clean (has not cut through the braid or has cut beyond the surface of the dielectric) readjust the diameter setting until the strip is clean.

If the exposed portion of the center conductor is bent at any time during the BNC installation operation, that portion of the bent center conductor must be cut off and the cable re-stripped.

The stripper should not need to have the stripping dimensions readjusted while making cable terminations on cable from a single reel of coax.

7. CRIMPING

The vendor is responsible for supplying a proper connection, that exceeds industry standards and warranting the work against failures. Samples of the center pin crimp must be sent to:

Transport Technical Support Quality Engineer

Ameritech

225 W. Randolph 24C

Chicago, IL 60606

The samples must be submitted and approved, by Ameritech before the vendor starts to utilize the center pin crimp method.

Clean the exposed portion of the center conductor of the coax with a disposable alcohol pad/ swab. If the center conductor is touched before the crimping operation is completed, the center conductor must be re-cleaned.

Place the pin fully on the center conductor.

Using the approved tool, crimp the center pin to the center conductor.

The crimp must have twelve indentations, spaced at three indentations every 45 degrees.

The crimp must be able to meet a center pin pull test of 6.5 pounds. This test is destructive. Should this test be performed in the field, the pin that was tested must be cut off, the cable re-stripped and a new pin terminated on the cable.

The certified center pin crimping process uses a high quality twelve indent tool (four sets of triple indenters) which applies 12 indents of equal depth and diameter to provide a gas tight connection between the interior of the center pin and the silver plated center conductor.

Visually inspect the crimp connection.

If the crimped connection does not meet the requirements, it is to be rejected and cut off. The cable is to be restripped the termination remade.

There must not be any crimping on the mating portion of the center pin nor shall any of the indents extend into the locking indention on the pin.

8. ASSEMBLY

Slip the ferrule onto cable.

Slightly flare the braid by gently twisting the braid, and place the aluminum shield under the support sleeve, with the braid over the support sleeve of the body of the connector.

The 734D cable has an aluminum shield under the braid that may need to be cut back to the .469” reference dimension if it does not slip into the support sleeve of the connector. An attempt shall be made on each connector to place the aluminum shield under the support sleeve of each connector.

When the center pin locks into place, a slight resistance will be felt by the installer and the braid should extend to the body of the connector. Braid should not extend beyond the crimped ferrule and the body of the BNC.

If the body of the connector has been locked into place on the center pin, and is removed for any reason, the connector body must be thrown away and a new body used. This is required because removing a body that has been locked on a center pin breaks away the Teflon retaining ring and allows the center pin to float within the connector body.

Slip the ferrule down to the body of the BNC and crimp the ferrule where the ferrule and body of the BNC meet. The crimp must extend to the junction of the ferrule and the connector body.

The ferrule must be butted against the connector body, be single crimped, and should exhibit six flat surfaces with no fins or excessive rounding at the sixty degree comers.

If the crimp does not exhibit these qualities the BNC must be remade, utilizing a new ferrule and body.

The pin height should now read between +20 mils to a - 20 mils with the revolution dial showing one revolution. The coaxial cable must be straight when making this measurement. Note the setting on revolution counting dial on the gauge, it should be on one. If it is not on one, the length is not correct even though the needle is within the tolerances.

The standard BNC details are shown in Figure 1 and Figure 3. If the BNC now meets all requirements, passes all continuity and resistance tests, the local Ameritech technicians should be asked to examine and sign off on the connectors. Only after the Ameritech representative has examined and accepted the connectors can they be locked into place. The BNC must be fully seated and have both locating pins seated in the openings for them in the body of the BNC.

Following the steps listed above does not relieve the vendor from meeting the national standards on BNCs. The finished product shall mate properly and supply a good connection.

Questions regarding this document should be directed to the Ameritech Transport Technical Support Members list below:

Byron Atkinson (312) 727-2662

Sam Pullum (312) 727-2285

Any variations of BNC assembly for 734D type cable must be sent to Ameritech in writing and approved before the vendor starts any coaxial cable assembly using the modification. Send any requests for assembly variations to:

Technical Support Transport Quality Engineer

Ameritech 225 W. Randolph 24C

Chicago, IL 60606

ATTACHMENT 3 - Attachment: BNC Acceptance Testing

NOTE: The material in attachments 1, 2 and 3 of this document will be removed from the next issue. The materials covered will be reissued under a separate document number. For questions, please contact Sam Pullum on (312) 727–2285.

CENTER PIN DEPTH GAUGE

Description: A dial gauge with an adapter to allow accurate measurement of the actual pin depth on the Bayonet Naval Connector (BNC).

This gauge should be used by an Ameritech technician to check the BNC center pin height before accepting a fiber bay from the vendor. All BNCs should be checked before placing any service on that connector.

A visual inspection should be done at the time of the pin depth check.

BNCs that do not meet all specified requirements will be replaced by a qualified technician. If the product is covered under warranty the vendor shall replace the BNC. The equipment engineer responsible for the installation should be notified if a vendor is required.

Any questions on BNCs may be referred to:

Byron Atkinson (312) 727-2662

Sam Pullum (312) 727-2285

VISUAL INSPECTION

Each BNC should be visually inspected for the following Items.

1. The ferrule (refer to Figure 1) should be butted against the connector body, be single crimped, and should exhibit six flat surfaces with no fins or excessive rounding at the 60 degree corners (refer to Figure 8).

2. The outer jacket should be under the ferrule.

3. The center pin will be gold in color, and should not be discolored in any way.

4. Each BNC will be firmly locked in place before being placed in service.

5. There must be a minimum of 2 inches from the ferrule to the first bend in the coaxial cable when the BNC is locked into place at the equipment or DSX location (see Figures 2 and 3).